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COST IMPACT OF MARINE POLLUTION ON RECREATION TRAVEL PATTERNS

by

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16. ABSTRACT

The report of the National Commission on Water Quality (NCWR) September 5, 1975, indicated the clean-up (from point sources) of the nation's lakes and rivers would result in an estimated $6 billion in increased economic activity annually by 1985 from opening more beaches, and $21.3 billion from commercial and recreational fishing. Another report from the NCWQ estimated an increase in usable beach capacity resulting from water quality improvement could result in an increase of between 1.2 percent and 2.7 percent of present seasonal recreational swimming and between 8 and 28 percent of present recreational swimming may relocate to beaches opened as a result of water quality improvement.

Improving the quality of water to the extent possible would result in a total travel cost associated with seasonal recreational (outdoor) swimming of $1,047.0 million. The clean-up of swimming waters would result in an estimated $112.5 million to $394.0 million in travel costs associated with swimming travel relocation. Taking the 25 percent proportion of marine recreation shoreline to total U.S. public beach capacity (in miles), it may be further estimated that the swimming relocation travel cost related to marine beaches ranges from $28.1 million to $98.5 million. A methodology for assessing the economic impact of a pollution occurrence on a recreation/tourist community is presented.

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FOREWORD

Effective regulatory and enforcement actions by the Environmental Protection Agency would be virtually impossible without sound scientific data on pollutants and their impact on environmental stability and human health. Responsibility for building this data base has been assigned to EPA's Office of Research and Development and its fifteen major field installations, one of which is the Corvallis Environmental Research Laboratory (CERL).

The primary mission of the Corvallis Laboratory is research on the effects of environmental pollutants on terrestrial, freshwater, and marine ecosystems; the behavior, effects and control of pollutants in lake systems; and the development of predictive models on the movement of pollutants in the biosphere.

This report completes work initially funded at the Washington Environmental Research Center, Washington, D.C., and transferred to the CERL for completion of the research effort.

A.F. Bartsch
Director, CERL

ABSTRACT

This study is a review of the literature concerning the impact of marine pollution on recreational travel patterns and travel costs to coastal beaches. Coastal beaches are the most heavily used national beaches. The adverse impact of offshore oil spill accidents and other pollution occurrences pose a significant economic impact to coastal areas through losses of revenue from tourist's expenditures.

The results are recorded in two parts. Chapter 2 is an investigation of the behaviorial responses of recreationists to beach pollution. Chapter 3 presents methods of measuring recreation travel costs resulting from marine pollution. Also included is a bibliography with abstracts of helpful references. The findings were that:

1. Marine pollution affecting one beach to the extent of adverse publicity and beach closings, also affects nearby beaches even though these beaches experience little pollution.

2. Water pollution clean-up can generate significant economic benefits through increased recreation participation and expenditures.

This report was submitted in fulfillment of Contract No. 68-01-3197 by Economics Research Associates under the sponsorship of the U. S. Environmental Protection Agency. This report covers the period May 5, 1975 to August 1976, and work was completed as of September 1977.

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This worked stemmed from earlier explorations of the relationship between water quality and recreation conducted by Drs. Dennis P. Tihanksy and Fred Able of the Economic Analysis Working Group, Office of Research and Development, Washington, Environmental Research Center of the U.S. Environmental Protection Agency. Dr. Tihansky was the initial EPA project monitor, and the work has been completed under the monitoring of Dr. John Jaksch, EPA, Corvallis Environmental Research Laboratory, Corvallis, Oregon.

Mr. Robert B. Shawn, Vice President of Economics Research Associates was the project supervisor. Mr. John K. Haeseler, Mr. Frederick F. Kennedy, Mr. Brian D. Bash, and Mr. B. Hayes McCarty, all of Economics Research Associates, contributed significantly to the economic data compilation and analysis of the study. B. Hayes McCarty was primarily responsible for the statistical analysis of the swimming-related travel cost. Mr. Roy Parks of Environmental Interface, Ltd., assisted in the beach survey work. Special thanks is also extended to Dr. Robert L. Adams of the U.S. Department of the Interior for his assistance in providing economic data from the Nationwide Plan for Outdoor Recreation.

Alexander B. Bigler
Principal Investigator

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Section I
INTRODUCTION

This report presents the findings of a study to measure the cost impact of marine pollution on recreation travel patterns. The increased costs to beach users seeking clean water as a result of polluted beaches and water heretofore generally has not been included in the cost/benefit equations for water clean-up programs. This problem is of concern as the result of environmental "accidents", such as oil tanker break-ups, which pose economic and social threats to recreation shorelines. In addition to the traditional cost/benefit analysis for setting priorities for development of water quality control facilities, the need for action in assessing the impact of sudden water pollution phenomena is widespread.

Water pollution which contaminates a recreation beach may be a long-standing condition; more often, it will be a recurring temporary event or a new occurrence resulting from an accident or unique environmental conditions. In either a long-term or a short-term recreation beach pollution event, there is little known about the additional costs to beach users in seeking out an alternative clean beach for their activities or, as a further impact, the economic impact on the local beach area.

In those cases where recreation benefits have been included in cost/benefit analyses of water quality control programs and projects, travel cost factors have either been neglected or conservatively estimated based upon intuitive assumptions or sketchy evidence. Having this information available in the cost/benefit process would be of benefit in two ways. First, it would provide a more complete picture of the investment tradeoffs at stake when a specific level of pollution abatement spending is determined. The second benefit of having available recreation travel cost information has to do with the implication of timing a remedial or pollution-corrective measure. This is particularly applicable to newly emerging or sudden pollution occurrences. It is in the case where a sudden pollution event occurs and contaminates a heavily used recreation beach where the impact may be of critical economic importance. Here is the situation in which local officials, city councilmen, mayors, county supervisors, governors and state legislators may find the traditional procedures of cost/benefit analysis are not responsive enough to assess potential damage or appraise the amount and kind of corrective measures which need to be quickly implemented.

Preliminary indications based upon certain judgmental assumptions (e.g., Walsh, Tihansky, and others) suggest that such costs to recreation users may be significant enough to merit more precise assessment and inclusion into allocation priorities for water pollution control expenditures. For this reason, the Environmental Protection Agency initiated this study project to develop a method with which to evolve national and regional estimates for recreation travel cost expenditures (and savings) for use (inclusion) in assessing pollution damages and benefits from pollution control programs.

This study effort focuses on coastal beaches. The main reason for this is that coastal beaches are some of the most heavily used nationally and thus more susceptible to adverse impacts of pollution. Coastal beaches serve as sensitive and useful indicators or barometers for interpreting the pollution impact on other coastal beaches, as well as at beaches along the nation's rivers and on the shores of inland lakes. Additionally, the adverse impacts of offshore oil spill accidents and other pollution occurrences and adverse aesthetic impacts of various kinds of coastal facilities have become priority environmental concerns.

Objectives and Scope of Travel Cost Impact Study

The basic aim of the study is to measure the travel cost impact of marine pollution on recreation beaches. The study involves determining the state-of-the-art of travel cost measures and estimating the economic impact of beach closures or decreased beach use due to pollution. The objectives of the study are:

1. Determine the current state of knowledge concerning travel cost methods of assessing recreation benefits;
2. Develop a method of assessing the impact of local beach pollution on recreation travel and the local economy;
3. Analyze a case history example of recreation travel changes (and costs) resulting from a beach pollution occurrence;
4. Prepare guidelines for assessing regional and national recreation travel impact resulting from beach pollution.

Procedures to assess the travel impact of beach pollution are based solely on secondary sources. There was no survey of participants (beach users) or households conducted for this study. Available data on demography, swimming participation rates, coastal-oriented vacation travel patterns, and related information were utilized to construct an aggregate relationship between beach pollution and recreation travel. The review of secondary sources concentrated primarily on studies which dealt with recreational benefits of water quality. While a wide variety of studies have been done on the economic, recreational and aesthetic impacts of pollution within various kinds of environments, the resources of this study did not permit a full review of these for their possible applicability to the marine recreation environment.

Another point which needs to be made clear at the onset of this report deals with the nature of how pollution impacts are counted, either as benefits or negative benefits. Increased costs to a recreationist in having to travel further to seek out a clean beach are negative benefits. The same cost may be counted as a positive benefit to the new beach location or to the providers of travel support services to the recreationists. Indeed, benefit/cost scholars have argued a variety of approaches to account for this positive/negative benefit relationship. For the purposes of this study, a direct approach to accounting for costs as positive (e.g., saving) or negative (from the standpoint of the beach user) was assumed, and consequently is reflected throughout the figures in this report.

Since there was no survey conducted, part of the link between beach pollution and recreation travel divergence is based upon several assumptions and hypotheses derived from observation of selected case histories of recent beach pollution occurrences. These assumptioss reflect the interpolation of observed recreation behavior associated with a beach pollution occurrence to available recreation travel and swimming participation pattern data. In addition to the case histories reviewed during this study, other recreation behavior related to beach pollution and water quality found in the literature was, in certain instances, reflected judmentally into the travel divergence assessment.

The Problem of Beach Pollution

For centuries man has used coastal waters and the seas both as places for pleasure and recreation and as receptacles to assimilate wastes. Although the oceans have an enormous capacity for wastes, this limit is now being exceeded, or at least threatened, along many coastal areas. The resulting damages affect both ecological stability and survivability of aquatic life, and human uses and recreational enjoyment of water resources. Modern day accidents at sea and along the coastline are also increasing in frequency and severity. Water pollution restricts human use of water in several ways:

- Commercial fishing is restricted due to contamination or destruction of fish or loss of breeding or feeding grounds;
- Navigation is reduced because of floating debris, or maintenance costs are increased due to presence of certain materials in the water;
- Shoreline property values may be reduced due to unpleasant views or odors;
- Aesthetic amenities may be harmed;
- Ecological relationships in aquatic systems may be damaged, interrupted, or destroyed;
- Water supply may be reduced; and
- Use of waters for recreation may decrease, or swimming, sport fishing, and boating activities may be eliminted.

The perspective and amount of damage to recreation activity from marine pollution is related to location, access, amount of water surface, and physical conditions (temperature, currents, tides, waves, etc.), length of shoreline, and configuration of water area and shoreline relationship. The way recreationists react to pollution damages under any given set of above marine conditions or circumstances is further related to their

1. Perception of the pollution in the context (e.g., activity or environment) within which it occurs;
2. Perception of the desirability of other (non-recreation) features or uses of the marine environment which will tend to hold them to a particular location or activity pattern; and
3. Preference and ability to pursue cleaner water elsewhere for recreation, rather than substitute another kind of (non-water) recreation.

Factors which influence these perceptions, preferences and abilities are discussed later in this report.

The results of such perception may be dramatic or subtle in influencing the beach user in pursuing a beach location for a recreation outing. It may vary from "don't go there because it's too dirty," to a very subtle influence on the choice between several beach options where one is selected because it has the overall image of being a "nicer and cleaner" place to be and enjoy.

There has been a general problem in formulating cost/benefit measures for water pollution control programs. The Environmental Protection Agency and other agencies have undertaken and sponsored substantial research to improve methods and data for assessing costs and benefits. Inadequate cost and benefit data results in

- Impeded progress;
- Neglected damages;
- Delays in legislation;
- Deflated economic incentive to control pollution;

- Handicapped identification of the most economically efficient selection among alternative waste management strategies;
- Continuation of water quality deterioration; and
- Loss to society of potential welfare gains by neglecting the correct solution.

The main body of work which most recently addressed the problem of beach pollution was sponsored by the U.S. National Commission on Water Quality. The work was conducted by Battelle Memorial Institute.[1] The study inventoried the amount of beach capcity in the U.S. which is affected by water pollution. Table 1 indicates the amount of U.S. public beach capacity as reported by the U.S. Bureau of Outdoor Recreation. By comparing BOR's total U.S. public beach capacity figures and the marine shoreline estimates of the U.S. Army Corps of Engineers, with the inventory assessments of the Battelle report, a general estimate of water quality effects on U.S. beach (marine) capacity can be made, as shown in Table 2.

- The use of between three and eight percent of national capacity (in acres) of public beaches is estimated to be constrained by degraded water quality.
- Of the beaches surveyed that were closed,
  - 39% of individual seasonal closings were less than two weeks duration;
  - 48% of closing incidents were for periods of up to one month;
  - 14% were classified as permanently closed;
  - 6% closed for at least one season.
- A maximum of 86 percent of the beaches presently polluted may be improved by implementation of the Water Quality Act (P.L. 92-500) and clean-up of point sources of pollution.

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[1] Moore, John L., Don E. Perin, and Ben G. Maiden, Benefits from Water Pollution Abatement: Beach Closings and Reopenings, prepared for the U.S. National Commission on Water Quality by Battelle Memorial Institute (Columbus, Ohio), PB251-221, National Technical Information Service, Springfield, Virginia 22161, February 1975, 500 pp.

Table 1

NATIONAL PUBLIC BEACH CAPACITY
(Excluding Alaska)

State	Beach Miles	Beach Acres
Alabama	68	613
Arizona	21	790
Arkansas	35	54
California	653	33,631
Colorado	6	3
Connecticut	43	661
Delaware	2	0
District of Columbia	0	0
Florida	243	8,218
Georgia	41	28
Hawaii	8	46
Idaho	39	83
Illinois	66	147
Indiana	28	548
Iowa	59	100
Kansas	50	163
Kentucky	2,115	418
Louisiana	9	14
Maine	21	30
Maryland	13	250
Massachusetts	33	1,487
Michigan	142	1,056
Minnesota	104	603
Mississippi	29	84
Missouri	17	21
Montana	20	65
Nebraska	31	71
Nevada	13	451
New Hampshire	12	48
New Jersey	18	108
New Mexico	1	3
New York	67	5,042
North Carolina	24	324
North Dakota	22	58
Ohio	128	83
Oklahoma	43	154
Oregon	49	625
Pennsylvania	43	201
Rhode Island	6	125
South Carolina	31	732
South Dakota	34	64
Tennessee	16	114
Texas	209	17,628
Utah	8	710
Vermont	5	33
Virginia	18	161
Washington	178	7,076
West Virginia	6	83
Wisconsin	8,591	275
Wyoming	7	33
Total	13,426	83.315

Source: U.S. Bureau of Outdoor Recreation

Table 2

ESTIMATED WATER QUALITY EFFECTS ON NATIONAL BEACH CAPACITY [1]

	Miles	Acres
National Public Beach[2] Capacity (excluding Alaska)	13,426	83,315
Total Marine Shoreline[3]	36,900 (100%)	
Public Recreation Use	3,400 (9%)	
Private Recreation Use	5,800 (16%)	
Nonrecreation Development	5,900 (16%)	
Undeveloped	21,800 (59%)	
Capacity Estimates from Surveyed Public Beaches[4]	3,651	37,674
Percent of BOR Capacity Covered by County Survey[4]	27%	45%
Range of National Public Capacity Affected Assuming Survey Included all Problem Beaches [4]	308-485 2%-4%	3,234-5,005 4%-6%
Range of National Public Capacity Affected Assuming Water Quality Effects in Proportion to Survey Estimates [4]	1,128-1,786 8.4%-13.3%	7,165-10,831 8.6%-13%

	Minimum	Maximum	% Increase Over 1972	Estimated % Marine[5]
Estimated Amount of Increase in Annual Swimming Activity Days from Water Quality Improvement (over 1972 levels) [4]	6,006,000	13,307,000	2.7%	25.3%
Estimated Increase of Activity Days at the Specific Areas Made Useable Through Water Quality Improvement [4]	36,000,000	134,000,000	28%	

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[1] Excluding Alaska.

[2] U.S. Bureau of Outdoor Recreation.

[3] U.S. Army Corps of Engineers.

[4] Moore, John L., Don E. Perin, and Ben G. Maiden, Benefits from Water Pollution Abatement: Beach Closings and Reopenings, prepared for the U.S. National Commission on Water Quality by Battelle Memorial Institute (Columbus, (Ohio), P.B. 251-221, National Technical Information Service, Springfield, Virginia 22161, February 1975, 500 pp.

[5] Based upon proportion of marine shoreline miles (3,400 miles) in public recreation use to total national public beach capacity in miles (13,426 miles).

- An increase in usable beach capacity resulting from water quality improvement could result in an increase of between 1.2 percent and 2.7 percent of present seasonal recreational swimming, given the present rate of participation.
- Between 8 and 28 percent of present recreational swimming may relocate to beaches opened as a result of water quality improvement.

The report of the National Commission on Water Quality, released September 5, 1975, indicated the cost to clean up (from point sources) the nation's lakes and rivers would be between $97 billion and $130 billion by 1983. Such an undertaking would result in an estimated $6.0 billion in increased economic activity annually by 1985 from opening more beaches, and $21.3 billion from commercial and recreational fishing.

These figures indicate expenditures by recreationists; they do not necessarily measure the full value of their recreation experience, which would be reflected in an additional measurement of surplus value. These estimates of potential economic gains for recreation activity also do not include the additional factor of travel cost savings by those who are now traveling further for clean beaches and swimming water, or the losses resulting from diverting to non-water-based recreation activity because there was no (perceived) alternative beach available. Again, it is assumed that travel cost savings would be added as recreation benefits to the beach user, as would beach recreation expenditures reallocated back to beach use be added to the amount of increased recreation economic activity.

Section II

BEHAVIORAL RESPONSES TO BEACH POLLUTION

This section provides an understanding of how people react to water and beach pollution so as to be better able to interpret or predict user reaction to a pollution occurrence. Subjects covered include a review of the kinds of pollution affecting swimming, the perception of water quality and water pollution, the relationship of this perception to recreation participation, and the identification of the characteristics of people who swim and the factors influencing their beach selection.

Review of Recreation Travel Cost Literature

A literature search on travel divergence and costs resulting from marine pollution revealed no empirical data or case studies directly with the subject. Several studies mentioned travel divergence or recreationists from beach pollution as a part of the overall pollution problem, but made no effort to measure this impact. Other studies dealt with the characteristics of recreation travel patterns, including beach users. While the literature search did not reveal methods or experiences in recreation travel changes due to pollution, it did provide a broad background of the kinds of pollution, recreation user and travel characteristics and the status of beach pollution in the nation. This information was adequate to enable the construction of a methodology to estimate travel diversion characteristics and costs resulting from beach pollution.

The verification of this methodology through survey of beach users to develop an empirically based substantiation of its accuracy remains to be done. However, it appears that the state of the art of sophisticated economic impact analysis is already far ahead of most decision-making institutions' ability to apply such techniques.

This study was organized to pursue the development of a method that would be functional and practical by using conventional sources of data and which could be easily applied to a particular beach pollution occurrence by those who need to make real world decisions for remedial action to a pollution problem. It was found, for instance (as discussed later), that beach pollution was not as widespread a phenomenon as it once was (say, in the 1960s and early 1970s). The Battelle report cited that almost 90 percent of the present beach pollution occurrences were not more than one month in duration -- in other words, temporary in nature. Pollution of a beach that will have dramatic impact on recreational travel and beach use is usually an occurrence resulting from an accident of man or nature, and therefore is generally temporary in duration and focused in scope. Consequently, information needs have become more immediate in order to judge the amount and timing of pollution abatement response.

For example, the blackened beaches in Santa Barbara, California, resulting from the offshore oil rig blowout in 1969 have almost completely recovered. But while a pollution accident, such as an oil spill, may recover on its own through natural processes over a period of years, other pollution occurrences may demand preventive or corrective action attention immediately or over a short period of time in order to avoid environmental and economic losses (costs).

The main problem in assessing recreation travel costs resulting from beach pollution is to "net out" the costs specifically related to pursuing clean water and beaches. This involves establishing a broader context of the kinds of pollution, the perception people hold for specific kinds of pollution, the social and economic characteristics of the recreationists, and the alternatives (e.g. other clean beaches) available for recreation. The literature search revealed other information about assessing travel costs resulting from beach pollution, as summarized below:

1. At least one national aggregate figure for net value loss due to pollution has been estimated (by Tihansky), and the National Commission on Water Quality has estimated the economic gain to recreation if water clean-up under the Water Quality Act were fully implemented.

2. The general response characteristics of people to beach pollution have been identified, although not accurately measured or evaluated in terms of travel costs.

3. An inventory of the current status of water quality of beaches in 38 of the states has been prepared for the National Commission on Water Quality. While this data was collected primarily by mail survey and telephone interviews with state officials, we can only assume the degree and accuracy of response gives a reliable indication of the proportion of U.S. beaches that are presently subject to deteriorated or polluted conditions.

4. Several studies have been reviewed which present theoretical or assumed approaches to assess recreational values or losses due to varying states of water quality. While these methods could be applied to calculating pollution related recreation travel cost, there still remains a lack of empirical data on such travel patterns and costs.

5. Another useful approach to this study was revealed in the course of the literature review. Many of the beaches near metropolitan areas which suffered severe pollution damages reported in the 1960s and early 1970s have improved in quality. Few beaches in the Great Lakes remain permanently closed now due to accelerated development of primary and secondary municipal sewage treatment systems.

It appears that the sewer outfalls which were subject to the most rapid clean-up were those upstream from public beaches. These sources of pollution were the most visible and felt by the public at their favorite beaches. These locations subsequently received higher priority for receiving early financial assistance for accelerated treatment plant construction.

Thus, a larger return of beach users can be found at many of the earlier polluted beaches. Discussions with some beach users at Hammond and Michigan City, Indiana, and with officials at the state and federal beaches at southern Lake Michigan, for example, found the perception of water pollution very low. Polluted beaches were "a long time ago" or "not any more." Occasional beach closings for a day or so, after a heavy rain and combined sewer overflows, occur but apparently do not present a significant problem.

With the limited information that could be found on the earlier EPA (Plassey) beach pollution survey in 1971, the current National Commission on Water Quality beach pollution survey seems to show a substantial improvement in beach quality in recent years rather than continued deterioration. The implication of this is that it may be useful to consider the further exploration of the extent to which beach use has come back after pollution clean-up. This approach would stress the positive value to recreation which has resulted from water quality improvement efforts in recent years. Attendance records of beaches previously closed, for example, would likely reveal a correlation of increased use associated with bringing on line new local waste water treatment systems.

Swimming and Beach Use as a Yardstick for Water-Based Recreation

The Outdoor Recreation Resources Review Commission in 1969 estimated that almost half (44 percent) of all outdoor recreation activity in some way was related to water. The U.S. Bureau of Outdoor Recreation further indicates that 34 percent of the U.S. population visit beaches to swim during the course of a year. Thus, deterioration of the quality of beaches and swimming areas is going to directly affect a significant portion of the population recreating in the outdoors. Moreover, swimmers are usually more sensitive than other users to beach conditions. 1/

Indeed, other factors are important besides the quality of water, such as the aesthetics of the surroundings, and others beside swimmers

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1/ Tihansky, Dennis P., "Recreational Welfare Losses from Water Pollution Along U.S. Coasts," Journal of Environmental Quality, Vol. 3, No. 4, October-December 1974, pp. 335-342.

are affected by pollution, such as boaters and people who visit or reside next to the coastline to enjoy its view and climate. When a reach of shoreline becomes polluted, however, it is usually the swimmers at a beach who feel it first and react initially. Other recreationists involved in water contact may also react in the same manner, such as surf fishermen or water skiers.

The assessment of beach swimmers thus serves as a relatively sensitive indicator of the perceptions and reactions of recreationists to water pollution. Similarly, the increased travel costs to beach users resulting from pollution reflect the largest sector of recreationists experiencing a travel divergence from pollution damages.

The Kinds of Water Pollution Which Affect Swimming

There are many parameters or conditions of water that constitute desirability from a recreation and aesthetic standpoint. These fall into two basic categories: (1) scientifically based standards relating to public health and safety, and (2) psychologically based standards which relate to those qualities perceived by people as being desirable recreation use of water.

Swimmers and beach users will react in different ways to various kinds of pollutants. By understanding these interactions, a better insight can be gained into predicting the kind and severity, and location of a polluted beach situation that will result in users searching for a cleaner alternative.

There are several conditions which water must meet for swimming and direct body contact.[1]

1. The area must be accessible and safe from physical hazards.
2. It must be aesthetically enjoyable.

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[1] Based in part on Ditton, R. B., and Edward H. Storey, The Identification and Critical Analysis of Selected Literature Dealing with the Recreation Aspects of Water Resources Use, Planning and Development, Water Resources Center, University of Illinois, 1969, p. 183.

3. It must contain no substance that is toxic upon ingestion or irritating to the eyes or skin of humans.

4. It must be reasonably free of pathogenic bacteria.

The basic Federal standards and criteria for water quality for aesthetics and recreation uses are shown in Table 3, and similar guidelines for Canada are shown in Table 4. Unless these conditions are met for a specific water resource, both physically and perceived, the participant of water-based recreation may be forced to seek another site, face a reduced quality of experience, or possibly be subject to physical damage.

Public health and safety standards generally remain constant, such as an in-stream standard of 200 coliform/ml for human health protection. Recreation oriented water quality standards on the other hand may vary according to (1) the values and preferences of the viewer, (2) the context in which a "pollutant" or condition is perceived, and (3) the character of the specific condition. For instance, studies have shown that floating debris is not such much a pollutant (e.g. , out of place) in front of a large factory as it is in a pristine pond.

A still more important example is where people may be swimming in bacteriologically contaminated water (high coliform count), but which may still be crystal clear. Because some contamination from bacteria and toxic substances is not visible, such pollution often may not register high in people's reactions.

Table 3

RECOMMENDED FEDERAL WATER QUALITY STANDARDS FOR AESTHETICS AND RECREATION 1/

Aesthetics

A. General Requirements

I. All surface waters should be capable of supporting life forms of aesthetic value.

II. Surface waters should be free of substances attributable to discharges or wastes as follows:

(a) Materials that will settle to form objectionable deposits.

(b) Floating debris, oil, scum, and other matter.

(c) Substances producing objectionable color, odor, taste, or turbidity.

(d) Materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in human, fish, and other animal life and plants.

(e) Substances and conditions or combinations thereof in concentrations which produce undesirable aquatic life.

Recreation

A. General Recreational Use of Surface Waters

I. Surface waters, with specific and limited exceptions, should be suitable for human use in recreation activities not involving significant risks of ingestion without reference to official designation of recreation as a water use. For this purpose, in addition to aesthetic criteria, surface waters should be maintained in a condition to minimize potential contamination by utilizing fecal coliform criteria for monitoring. In the absence of local epidemiological experience, the Subcommittee suggests an average not to exceed 2,000 fecal coliforms per 100 ml and a maximum of 4,000 per 100 ml., except in specified mixing zones adjacent to outfalls.

B. Primary Contact Recreation

I. Criteria for mandatory factors

(a) Fecal coliform should be used as the indicator organism for evaluating the microbiological suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples for any 30-day period of the recreation season, the fecal coliform content of primary

Table 3

(Continued)

contact recreation waters shall not exceed a log mean of 200/100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 ml.

(b) In primary contact recreation waters, the pH should be within range of 6.5-8.3 except when due to natural causes and in no case shall be less than 5.0 nor more than 9.0. When the pH is less than 6.5 or more than 8.3, discharge of substances which further increases unfavorable total acidity or alkalinity should be limited.

II. Criteria for undesirable factors

(a) For primary contact waters, clarity should be such that a Secchi disc is visible at a minimum depth of 4 feet. In "learn to swim" areas, the clarity should be such that a Secchi disc on the bottom is visible. In diving areas, the clarity shall equal the minimum required by safety standards, depending on the height of the diving platform or board.

(b) In primary contact recreation waters, except where caused by natural conditions, maximum water temperatures should not exceed 85 F (30 C).

III. Marine waters

The Subcommittee suggests, as a general practice, application of a single set of criteria for fresh, estuarine, and marine waters.

1/ Water Quality Criteria, Report of the National Technical Advisory Committee for the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C., April 1, 1968, pp. 3, 4.

Table 4

WATER QUALITY GUIDELINES FOR DIRECT CONTACT RECREATION
(Swimming, Bathing, Wading, Water Skiing)

Parameter	Objective	Maximum Limit
Total Coliform Organisms (Median MPN)	Less than 100	500
Faecal Coliform Organisms (Median MPN)	Less than 20	200
Turbidity (Jackson Unit)	Less than 5	50
Secchi Disc Visibility (minimum)	20 f (6 m)	4 f (1.2 m)
pH, units	6.5-8.3	Over 6; less than 9
Temperature	No increase over natural	30°F. (85°F.)
Total Plankton Concentration (Biomass)	No increase (over normal level) by induced growth.	Not more than 5,000 org. /l over normal level.
Color (Pt.-Co Scale)	Less than 15	100
Odor (T.O.N.)	Inoffensive	16
Ether Extractible Oils & Grease (mg/l)	No noticeable oil slicks or floating grease	5 mg/l
Synthetic Detergents	Less than foam-threshhold (usually less than 0.5 mg/l as ABS-equiv)	2 mg/l as ABS-equiv.
Toxic Substances	Drinking Water Quality Standards	Not to exceed emergency limits for toxicants
Gross Radioactivity	None	Less than 10 pc/l

Source: Canada, Department of Environment, Water Management Service, Inland Waters Branch, "Guidelines for Water Quality Objectives and Standards - A Preliminary Report" Technical Bulletin No. 67 (Ottawa: Queen's Printer, 1972), p. 15.

Major Pollution Parameters

Fecal coliforms, odors, algal-macroscums, fish habitat, turbidity and wildlife support have been identified by the National Planning Association as the most significant water quality characteristics with respect to their influence upon water-related recreation participation.[1]

The following water quality parameters are generally considered as the most relevant variables affecting water-based recreation and fish and wildlife conditions.

- Fecal coliform
- Phosphorus (total)
- Nitrogen (total)
- D.O.
- Turbidity (Jackson units)
- Temperature
- pH
- Total dissolved solids

"The effects of pollutants depend on a variety of interrelated factors, the acidity or alkalinity of water, its temperature, the degree of dilution and mixing, chemical and biological effects, the rate of flow of the water, and the reinforcing or counteracting effects of contaminants on one another."[2]

Effluents from municipal sewage systems and industrial plants are the most notable causes of pollution in recreational waters. Other causes of pollution are erosion and the recreationists themselves (i.e., broken glass and waste discharges from boats). The pollutants are varied in nature as their effects upon human health and the aesthetic quality of the water. Table 5 indicates a list of common contaminants and their effects. Table 6 further illustrates standards for recreation water contact.

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[1] Gutnamis, Ivars, et al, Water-Related Recreation Benefits Resulting from P.L. 92-500. Vol. I and Vol. II, prepared for the U.S. National Commission on Water Quality by the National Planning Association, 1606 New Hampshire Avenue, N.W., Washington, D.C. 20009, November 1975, 900 pp.

[2] A Report by the Subcommittee on Environmental Improvement, Committee on Chemistry and Public Affairs, Cleaning Our Environment: The Chemical Basis for Action, Washington, D.C., 1969, p. 146.

Table 5

WATER QUALITY CONTAMINANTS AND THEIR EFFECTS ON RECREATION USE

Typical Contaminants	Effect on Recreation Use
Phenols*	Impact obnoxious odors and tastes to the water and the fish within. In very small concentrations they are toxic to fish.
Acids and alkalines* pH Total Alkalinity Hardness	Toxic to aquatic life and damaging to recreational equipment.
Heavy metals, e.g., lead, arsenic, zinc, and chromium	Toxic to fish, wildlife, and humans
Oxygen-consuming substances* e.g., starches, sugars, organic wastes BOC COD	Detrimental to fish and other aquatic life and can cause odor and taste problems.
Chlorine	May be detrimental to fish and other aquatic life. Causes eye irritation in swimming pools.
Chloride	
Soil Suspended solids	In large amounts, clays and silts are visually unsightly, detrimental to aquatic life, and sedimentations tend to shorten the life of reservoirs and lakes. Soil can be a carrier of harmful chemicals such as phosphates and pesticides
Oils*, gasoline, and greases	Injurious to fish and wildlife aesthetically displeasing and damaging to recreation equipment and beach areas. Usually temporary effects as long as source present. Will breakdown.
Dissolved solids	Little effect on swimming contact.
Condition of bottom	Negative aesthetic impact, some hazard if dangerous sharp objects.

*Also found in combination with several other pollutants.

Table 5
(Continued)

Typical Contaminants	Effect on Recreation Use
Color	
Dyes	Some varieties are toxic to fish and all affect the water's natural color.
Color	
Clarity-turbidity	
Temperature	May impair aesthetic quality of swimming water and has a deleterious affect on other elements contained within the body of water. Extremes may harm aquatic life or plants, or may stimulate growth of nuisance aquatic plants. Under certain conditions may be beneficial for swimming in cold bodies of water.
Radiation	Certain rays or radioactive substances above certain levels may be detrimental to aquatic plant and animal life and a threat to human health.
Pesticides*	Harmful to all forms of aquatic life and any organisms ingesting the water, including humans.
Human digestive wastes and associated bacteria	Causes obnoxious odors, is visually unsightly, and detrimental to human health and aquatic life.
Fecal coliform	
Nutrients, including fertilizers (phosphates)*	Stimulates nuisance aquatic growths which are aesthetically and physically detrimental to recreation activities.
Nitrate	
NO_2 Nitrogen	
NO_3 Nitrogen	
Ammonia Nitrogen	

*Also found in combination with several other pollutants.

Source: U.S. Bureau of Outdoor Recreation, Water Oriented Outdoor Recreation: Lake Superior Basin, Lake Central Region; U.S. Bureau of Outdoor Recreation, Ann Arbor, Michigan, 1970, p. 6-7; Eisen, Jill, "The Benefits and Costs of an Increment in Water Quality", Section II, Water Resource Policies in Wisconsin: Problems of a Metropolitan Region; Water Resources Center, University of Wisconsin, Madison, Wisconsin, 1971; Ditton, Robert and Thomas Goodale, Marine Recreational Uses of Green Bay: A Study of Human Behavior and Attitude Patterns, WIS-SG-72-217, University of Wisconsin, Green Bay, Wisconsin, 1972.

Table 6

WATER QUALITY RECREATION STANDARDS

	Swimming	Fishing	Boating	Camping
Fecal Coliform	1000/[a] 100 ml			
Phosphorus (Total)			.01 mg/l[ef]	.01 mg/l[ef]
Nitrogen (Total)			.6 mg/l[g]	.6 mg/l[g]
D.O.		5 mg/l[c]	3 mg/l[h]	3 mg/l[h]
Turbidity	4' secchi[a] disc --------- 10 JTU[b]	50 JTU[a]		
Temperature	85°F [a]	79°F 60°F [d]		
pH	6.5-8.3[a]	6.7-8.6[c]		
Total Dissolved Solids		2000 mg/l[d]		

Note: Footnotes on page 23.

Source: Gutnamis, et al (1975), *op. cit.*, p. 81.

a/ Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Washington, D.C., 1968.

b/ This source suggests 5-JTU for direct contact use of water which included drinking. A 10-JTU standard appears more appropriate for swimming. Land Use, Urban Form and Environmental Quality, University of Chicago, Department of Geography, Research Paper #155, Chicago, Illinois, 1974.

c/ M.M. Ellis, "Water Purity Standards for Fresh Water Fishes", Special Scientific Report #2, Department of the Interior, Washington, D.C. 1944

d/ Warm and cold water species standards, respectively, derived from optimum temperatures for a representative selection of fish species. Jack Edward McKee and Harold W. Wolf, Water Quality Criteria, prepared for the State Water Quality Control Board, Sacramento, California 1963.

e/ J.J. Curry and S.L. Wilson, "Effect of Sewage Borne Phosphorus on Algae", Sewage and Industrial Wastes, 27, 1262 (1955).

f/ Total phosphorus limit to prevent biological nuisances, K.M. Mackenthun, "The Phosphorus Problem", Journal of American Water Works Association, 60 (9), 1047-1054 (1968).

g/ W. Muller, "Nitrogen Content and Pollution of Streams", Water Pollution Abstracts, 28, 454 (1955)

h/ Odor Threshold for Boating, Paul F. Davidson, F.G. Adams, and Joseph Seneca, "The Social Value of Water Recreation Facilities Resulting from an Improvement in Water Quality", Water Resources Research, Knesse & Smith (eds.) Johns Hopkins Press: Baltimore, 1966.

Health, safety and comfort are primary water quality considerations for direct contact recreation activities. Disease risk can be introduced to bathing waters from:[1]

1. Fecal discharge of man and other warm blooded animals.
2. Stormwater runoff.
3. Wastes spilled from boats
4. Dredging operations.
4. Drainage from landfill operations.
6. Recirculation of materials from ocean dumps.
7. Discharges of untreated or poorly treated wastes.
8. Poorly located ocean outfalls for effluents.
9. Flooding backwash.

Fecal coliform and total coliform are dominant measurable direct contact activities. Staphylococci, streptococci, and other enterococci have been suggested as more appropriate measures of the suitability of water for such recreation uses. However, these microbiological indicators do not necessarily mean that disease germs are present.[2] [3] These hazards are also generally not perceived by participants or associated with a pollution problem.[4] In cases where the danger of disease has been effectively communicated by an agency along with a quarantine of a beach however, users will indeed give notice, and avoid water contact as in the case of Long Island beaches in the early summer of 1976. The Long Island pollution occurrence is discussed later in this report.

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[1] Geldreich, Edwin E., "Microbiological Criteria Concepts for Coastal Bathing Waters", Oceans Management, Vol. 2, No. 3, p. 225-227.

[2] Water Quality Criteria, 1972, A Report to the Committee on Water Quality Criteria, EPA R 373033, March 1973.

[3] Nicolson, J. A., and A. C. Mace, Jr., "Water Quality Perception by Users: Can It Supplement Objective Water Quality Measures ?", Water Resources Bulletin, Vol. II, No. 6, December 1975, American Water Resources Associate, pp 1197-1207

[4] Ditton and Storey (1969), op. cit., p. 157.

The Perception of Water Quality: What is Perceived

The sources, types and effects of pollution on water-based recreation activities are discussed above. However, the recreationists' perception of water pollution conditions are what determine their participation and level of satisfaction. It should be noted that even though a body of water may meet the biological and chemical standards of quality, it may still receive little use because the recreationists perceive it as unsatisfactory.[1/] This is due to many psychological factors and the fact that recreationists often base their perception of pollution on what they can see and smell. Figure 1 is a graphic representation of the chain of events involved in the relationship between water quality and recreation participation.

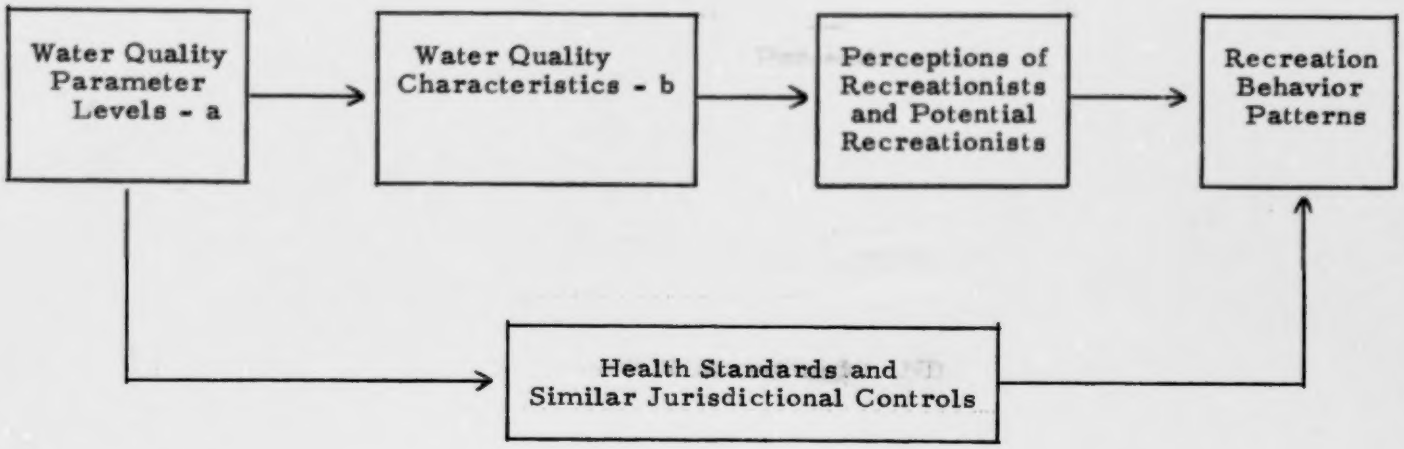
People perceive water pollution in a number of different ways through sight, smell, and touch. Below are reviewed several studies which have attempted to determine the character of human perceptions of water quality conditions:

- Elizabeth David (1971), with a representative sample of 574 adults in Wisconsin, studied the effects of perceived water quality on recreation with no reference to a specific water body. Respondents were requested to provide their own definitions of water pollution, as follows: 40 percent mentioned algae and green scum; 35 percent cited murky, dark water; 20 percent mentioned smell and floating debris; and 10 percent noted sewage, weeds, and suds as indicators of unacceptable water quality conditions. As specific deterrents to swimming, green scum and algae were identified 80 percent of the time, and cans and glass on the bottom were identified 90 percent of the time.
- Nicolson and Mace (1975) also found algae, scum and murky water of concern to recreationists, as shown in Table 7.

[1/] Ditton and Storey (1969), op. cit., p. 162.

Figure 1

THE WATER QUALITY/RECREATION PARTICIPATION RELATIONSHIP


Water Quality Parameter Levels - a
Water Quality Characteristics - b
Perceptions of Recreationists and Potential Recreationists
Recreation Behavior Patterns
Health Standards and Similar Jurisdictional Controls

a. For example, measured levels of D.O., turbidity, pH, temperature, phosphorus, nitrogen, etc.
b. The (less quantifiable) cumulative results of individual parameters. Examples include odors, algal scums, scarcity of fish, dark and murky water, etc.

Source: Gutnamis, et al (1975), op. cit.

Table 7

PERCENTAGE OF TIMES THAT INDICATORS OF WATER POLLUTION OCCUR IN INTERVIEWEE DESCRIPTIONS OF POLLUTED WATER

Indicator	Average
Algae and green scum	32%
Murky, dark water	26
Floating debris	17
Other[1]	10
Strong odor	8
Sewage	2
Suds or foam	2
No answer	2
Weeds	1
Total	100%

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[1] Other terms used as indicators were stagnant, dead fish, silty, invisible, nitrates, mercury, sludge, filthy, etc.

Scurce: Nicolson, J.A. and A.C. Mace, Jr., (1970), *op. cit.*, p 1201.

- A comparison of the Elizabeth David and Nicolson and Mace studies is shown in the table below:

Parameter	Perceived Pollution (Percent Respondents)	
	Nicolson	David
Algae and green scum	32	40
Murky, dark water	26	35
Floating debris	17	20

- Roberts (1973) found the general perception of water quality related to (1) industrial wastes, (2) unhealthy bacteria, (3) general mess, (4) trash and garbage, and (5) municipal wastes. 1/

- Eisen (1971) found that approximately 60 percent of respondents of a survey of ways in which Lake Michigan is perceived to be polluted stated pollution problems are not directly associated with industrial and municipal effluents, as illustrated in Table 5. It may also be noted in Table 8 that over 60 percent of the perceived pollutants - and those perceived the most - are subject to clean-up through relatively inexpensive maintenance practices.

- In a study of Green Bay, Wisconsin, by Ditton and Goodale (1972), residents responded to the physical properties and pollution variables of the water. It was found that those conditions most readily observed were selected to be the greatest problem for Bay users, as summarized in Table 9.

- Studies of pollution perception by Roberts (1973) tend to indicate that water pollution, as part of overall environmental quality, is mostly perceived by the middle income and educated range of people, and highly trained professionals (and some housewives), as demonstrated in Tables 10a, 10b, and 10c.

- Myles (1970) survey of Lake Tahoe beaches also indicated reactions to dirty beaches was much greater in a negative perception, than perceptions of clean or unpolluted conditions. (see Tables 11a and 11b).

1/ Roberts, Marc., et al, Measurement and Distribution of the Costs and Benefits of Water Pollution Control, Urban Systems Research and Engineering, Cambridge, Mass., Nov. 1973. EPA draft, unpublished (EPA Contract No. R-801232, c/o Dr. Fred H. Abel).

Table 8

PUBLIC PERCEPTION OF SWIMMING AREA QUALITY CHARACTERISTICS

Individual Perception of Pollution of Lake Michigan at Milwaukee Beaches*			Pollution as Defined by Respondent	Water Quality Attributes as a Deterrent to Swimming	Water Quality Attributes as an Indicator of Pollution**	Water Quality Definition and Deterrent Effects***	
	(Percent of Respondents)		(Percent of Total Responses Mentioning Each Attribute)				(Percent of Total Samples)
Dead Fish, Alewives	32.2%	Algae	40	80	40	Algae, Seaweed, Moss	47
Debris, Trash, People Throwing Things in the Water	23.1	Cans and Glass	5	70	1	Dead Fish	33
Industrial Wastes	10.9	Suds and Foam	10	30	25	Odors	28
Scum, Algae, Seaweed	9.2	Debris	20	40	10		
Dirty Looking, Bad Color	9.2	Murky, Dark Water	35	40	20		
Sewage, Drainage	8.4	Weeds	10	40	3		
Beer Cans, Pop Bottles, Broken Glass		Odor	20	-	-		
Smells Bad	2.5	Sewage	10	-	-		
Oil Film	1.3						
Other	.8						
Total	100.0%						

Source: *J. M. Eisen, "The Benefits and Costs of an Increment in Water Quality", Reprinted with Modifications from Section H of Technical Report OWRR B-038-WIS, Vol, III, Water Resource Policies in Wisconsin, Problems of Metropolitan Regions. Water Resources Center, University of Wisconsin, 1971.

**E. L. David, "Public Perceptions of Water Quality", Water Resource Research, June 1971.

***W. G. Simpson, and G. K. Kamitakahara, Opinions on Recreation and Pollution in Lake Ontario, Toronto, Canada, Great Lakes Institute, University of Toronto, 1971.

Table 9

MAJOR PROBLEMS FOR RECREATION USERS OF GREEN BAY, WISCONSIN

Physical Variables	Percent
Water is too cold	6.9%
Unpleasant smell	46.7
Wind	6.5
Waves	4.1
Junk on the bottom	20.5
Too many weeds	15.3%
Pollution Variables	**Percent**
Water is cloudy	12.6%
Chemicals	11.7
Harmful bacteria	16.1
Suds, film, foam	14.1
Dead fish	45.5%

Source: Ditton, Robert and Thomas Goodale, Marine Recreational Uses of Green Bay. A Study of Human Behavior and Attitude Patterns, WIS-SG-72-217. University of Wisconsin, Green Bay, Wisconsin, 1972.

Table 10a

PERCEPTION OF WATER QUALITY OF BOSTON WATER BODIES BY INCOME GROUP, CROSS TABULATION OF INCOME BY MOST SERIOUS ENVIRONMENTAL PROBLEM: UNSTRUCTURED RESPONSE - BOSTON PHONE SURVEY

Family Income	Air Pollution	Water Pollution	Trash/ Garbage	Noise	Ugliness	Industrial Pollution	All Pollution in General	Cars	Attitudes/ Rhetoric	Resource Depletion	Energy Shortage	Other	Row Total
Under $3,000	6	1	1	0	0	2	1	8	3	1	1	1	25
$3,000-$5,000	3	1	0	2	0	1	3	7	1	0	0	0	18
$5,000-$10,000	12	6	3	1	1	5	3	11	1	0	0	2	45
$10,000-$15,000	19	15	2	0	0	7	2	9	2	0	2	10	68
$15,000-$20,000	15	14	3	0	1	1	1	10	3	2	2	3	55
$20,000-$25,000	5	6	2	0	0	1	2	3	3	1	1	1	24
Over $25,000	17	7	4	0	0	2	3	5	5	4	2	4	53
Total	77	50	14	3	2	19	15	53	18	8	8	21	289

Source: Roberts, Marc J., et al, Measurement and Distribution of the Costs and Benefits of Water Pollution Control, Urban Systems Research and Engineering, Cambridge, Massachusetts, November 1973. EPA draft, unpublished (EPA Contract No. R-801232, c/o Dr. Fred Abel), p. II-61.

Table 10b

PERCEPTION OF WATER QUALITY OF BOSTON WATER BODIES BY INCOME GROUP, CROSS TABULATION OF EDUCATION BY MOST SERIOUS ENVIRONMENTAL PROBLEM: UNSTRUCTURED RESPONSE - BOSTON PHONE SURVEY

Education	Air Pollution	Water Pollution	Trash/ Garbage	Noise	Ugliness	Industrial Pollution	All Pollution in General	Cars	Attitudes/ Rhetoric	Resource Depletion	Energy Short-age	Other	Row Total
Higher Degree	24	12	2	1	0	1	4	8	3	3	3	2	6
College Degree	21	16	4	6	1	7	4	14	9	2	3	10	9
Some Post Secondary	16	11	6	1	0	3	3	10	2	2	0	8	6
High School	11	10	2	1	1	8	3	20	4	0	2	1	6
Grade School	5	0	0	0	0	0	1	3	1	0	0	0	1
Less Than Grade School	1	1	0	0	0	1	0	1	0	1	0	0	5
Total	78	50	14	3	2	20	15	55	19	8	8	21	33

Source: Roberts, Marc J., et al, Measurement and Distribution of the Costs and Benefits of Water Pollution Control, Urban Systems Research and Engineering, Cambridge, Massachusetts, November 1973. EPA draft, unpublished (EPA Contract No. R-801232, c/o Dr. Fred H. Abel), p. II-62

Table 10c

PERCEPTION OF WATER QUALITY OF BOSTON WATER BODIES BY OCCUPATIONAL GROUPS CROSS TABULATION OF OCCUPATION BY MOST SERIOUS ENVIRONMENTAL PROBLEM: UNSTRUCTURED RESPONSE - BOSTON PHONE SURVEY

Occupations	Air Pollution	Water Pollution	Trash/ Garbage	Noise	Ugliness	Industrial Pollution	All Pollution in General	Cars	Attitudes/ Rhetoric	Resource Depletion	Energy Shortage	Other	Row Total
Professionals	20	8	0	0	0	0	2	2	3	4	2	4	45
Teachers	5	8	1	0	0	1	2	4	1	0	2	2	24
Managers	12	7	5	0	0	1	1	6	1	0	0	2	37
Clerical/Technical	15	7	5	0	2	4	4	10	2	2	0	5	51
Skilled Workers	7	5	0	0	0	4	0	5	3	0	0	0	24
Unskilled Workers	0	3	0	1	0	1	0	4	1	0	0	0	10
Housewives	10	10	4	0	0	5	5	15	3	0	2	3	57
Retired	5	3	0	1	0	3	1	6	2	0	1	2	24
Students	4	2	0	1	0	2	0	2	3	2	0	3	19
Total	78	50	13	3	2	20	15	54	19	8	8	21	291

Source: Roberts, Marc J., et al, Measurement and Distribution of the Costs and Benefits of Water Pollution Control, Urban Systems Research and Engineering, Cambridge, Massachusetts. Nov. 1973. EPA draft, unpublished (EPA Contract No. R-801232, c/o Dr. Fred H. Abel), p. II-63.

Table 11a

REASONS FOR VISITING LAKE TAHOE BEACHES

Reasons for Visit	Tahoe		
	Cave Rock	Sand Harbor	Hidden Beach
	(Percent Answering)		
Like it, for vague reasons or no reasons	15%	21%	9%
Nice for water skiing	0	0	0
Clean, good facilities	0	3	2
Not crowded, quiet	3	0	4
Good scenery	0	3	2
Near or convenient, good roads	0	10	7
Good swimming, beach, other activities	3	4	7
Better than other places	0	2	2
Habitually come here, been here before	9	14	21
No other place available	0	1	2
Water temperature	0	0	2
Like fishing	18	0	0
Passing through, happen to be in the area	6	5	2
Heard about, wanted to see, recommended	9	6	9
For a change, to get away	3	1	2
Other	34	30	29
No answer	0%	0%	0%

Source: Myles, George A., Effect of Quality Factors on Water-Based Recreation in Western Nevada, Desert Research Institute Progress Report Series No. 3E, Center for Water Resources Research, University of Nevada, Reno, Nevada, February 1970 (NTIS PB 195-778), p. 10.

Table 11b

PERCEPTIONS OF LAKE TAHOE BEACHES

Comments	Cave Rock[1]	Tahoe Sand Harbor	Hidden Beach
	(Percent Answering)		
Like it, vague reasons	29	51	30
Like it because it is clean	3	9	0
Like it because it is sandy	0	2	0
Don't know, all right, no strong opinions	6	1	2
Dislike the natural litter	0	0	0
Need more area	24	1	0
Dislike it for vague reasons	3	0	0
It should be cleaner, it is dirty or littered	0	22	60
Other	32	14	8
No answer	3	0	0

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[1] At Cave Rock, nine percent said they didn't need a beach and six percent said it was good for water skiing.

Source: Myles (1970), op. cit., p 14.

Relationship of Perception to Recreation Activity

Research relating quantitative water quality measurements directly to (with) participation behavior of water-based recreationists is limited. The following qualitative efforts have addressed the sensitivity of recreationist behavior to water quality:

- A survey by Nicolson and Mace (1975) of visitors to these Minnesota lakes found 62 percent said their lives had not been affected by water pollution and 25 percent listed curtailment of recreation as a primary result of perceived water pollution. Most respondents (over 90 percent) perceived water pollution strictly on a visual basis because less than 10 percent mentioned nonvisual indicators.
- A survey by Willeke (1968) of households in the San Francisco area found the following reactions to polluted conditions of bay water:
    - no affect on boating, sailing or fishing;
    - 1/5 of adult population either modified or refrained from swimming in the bay; and
    - 5 percent of water skiers refrained from using the bay.
- Ditton and Goodale found that recreation behavior patterns do respond to water quality conditions. A strong dislocation of use resulting from degraded water quality was documented in their study of Green Bay (Wisconsin) as a recreational resource. In that study, dislocation was found to be greatest for swimming, less for fishing, and least for boating. 1/
- Megli, Long and Gamble (1971) began their research efforts with the hypothesis that recreational use of streams is directly related to the water quality of those streams and that as water quality varies so does

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1/ Ditton, Robert B. and Thomas L. Goodale, "Attitudes into Actions: Perceiving and Responding to a Degraded Water Resource." Reprinted from Proceedings of the Sixteenth Conference on Great Lakes Research, Sea Grant College Reprint, WIS-SG-74-348, April 1973, p. 95.

recreational activity. A sample of streams in Pennsylvania was selected for the study. Dissolved oxygen was found to be the parameter which which provided a concrete expression of the water quality/recreation participation relationship. 1/

- Wotter (1970) reports that both total and fecal coliform amounts have shown little correlation with either visitor use. 2/
- Moore, et al (1975) estimated that 72 percent of the official closures of beaches due to water quality problems were due to high coliform or fecal coliform counts. 3/
- Tihansky and Jolly (1974) found at least a subtle direct relationship between specific water quality parameter improvements (in D.O., pH, and total dissolved solids) and water-based recreation activities. (The relationship associated with fishing activities was much stronger.)
- For activities other than fishing, no one has identified a relationship between water quality parameter measurements and recreation participation behavior in quantitative manner.
- Nemerow and Faro (1970) concluded that improving the severely polluted quality of Onondaga Lake in New York to the high quality level of that of nearby Green Lake would increase annual visits from 384,166 to 580,290, an increase of 51 percent. 4/
- Reiling, et al (9173) estimated that the increase in blue-green algae in Klamath Lake, Oregon, would increase the average length of stay per visit from 1.97 to 2.41 days, and an increase in

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1/ Megli, D.L., et al, "An Analysis of the Relationship Between Stream Water Quality and Regional Income Generated by Water-Oriented Recreationists", Institute for Research on Land and Water Resources, Pennsylvania State University, December 1971.

2/ Wotter, J.C. "Water Quality within the Boundary Waters Canoe Area", in The Quetico-Superior Foundation, Institute on the Boundary Waters Canoe Area, C.N. Ryberg and S. Ryberg, Editors; Quetico-Superior Foundation, Minneapolis, Minnesota, p. 28.

3/ Moore, et al (1975), op. cit.

4/ Nemerow, Nelson L. and Robert C. Faro, "Measurement of the Total Dollar Benefit of Water Pollution Control", Part B, Benefits of Water Quality Enhancement, Water Pollution Control Research Series 16110 DAJ 12/70, Water Quality Office, U.S. Environmental Protection Agency, Washington, D.C. 20242, December 1970, pp. 105 and 115.

the number of visits by 60 percent. Further lowering the water temperature of the lake and improving the beaches would result in a cumulative increase of visits of 158 percent. 1/

- Bishop and Aukerman (1970) developed a ranking of pollution parameters which would effect recreation use of water, as shown in Tables 12 through 17 A survey of attitudes and behavior of swimmers, boaters, fisherman and sightseers toward selected water quality and site characteristics of recreation lakes in central Illinois was conducted by Bishop in 1970. 2/ While the findings of this study relate to inland fresh water recreation lakes, the perceptions and behavior of swimmers may provide some general characteristics which can be anticipated in influencing marine beach users.

The following implications of swimmer attitudes behavior may be drawn from the previous tables and the Bishop study.

- Swimmers' perceptions of water quality characteristics focus on favorable characteristics of cleanliness, clarity and temperature; swimmers are primarily concerned about unfavorable characteristics of muddy, dirty and unclear water.

- There are strong individual differences in descriptions of the water, even within the four activity groups. People can look at the same object or condition and perceive it to have opposite characteristics. There were large number of people who gave completely opposite descriptions of water clarity, for example.

- When all descriptions are considered, approximately half are unfavorable. Swimmers and fishermen are slighly more likely to give favorable rather than unfavorable descriptions, and boaters and sightseers are slightly more likely to give unfavorable descriptions.

1/ Reiling, S. D., et al, Economic Benefits from an Improvement in Water Quality, EPA-R5-73-008, Office of Research and Monitoring U.S. Environmental Protection Agency, Washington, D.C., 20460, January 1973, pp. 96,97.

2/ Bishop, Doyle W., and Robert Aukerman. "Water Quality Criteria for Selected Recreation Uses." WRC Research Report #33, University of Illinois Water Resources Center, Urbana, Illinois, 1970 (NTIS-PB-195-164).

- People's perceptions may differ according to an individual's values, experience, degree on contact, expectations, needs and other socioeconomic background. (Such differences are revealed to a greater extent in "self reporting" kind of survey questionnaires or interviews. Survey techniques involving more socioeconomic stratification data collection and more structured presentation of parameters - water quality - are able to achieve greater consistency of results.)

- While swimmers view the overall attractive characteristics of the water generally within the overall context or environment of a recreation lake site, water becomes a predominant factor in perceiving the site when the quality of the water is seen as unattractive.

- What swimmers like to have most associated with water is available recreation activities and facilities, closely followed by clean water at a comfortable temperature. On the other hand, what swimmers like least about water at a recreation site is dirty and unclear water.

- The top-ranked features liked most in all activity groups have little to do with quality of the water per se. Such things as the presence or availability of activities, the general attractiveness of the water, and the convenience of it are desired characteristics. Features least liked are directly concerned with water quality itself, particularly dirtiness and lack of clarity. "The implication of these results for water quality planning and management might be that the recreationist will not necessarily notice the water itself when it is of good quality, but will notice its poor quality. Or to state the conclusion somewhat more broadly (and more cautiously since it is not given directly by the data), those properties of water which, when present, would cause recreationists to be satisfied are not necessarily the same ones that would cause dissatisfaction if they were absent."[1/]

- It appears that if there were increases in the amounts of all of the characteristics, swimmers would be highly likely to terminate their use of the site. It

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[1/] Bishop and Aukerman (1970) op. cit., p. 45.

appears that swimmers could be turned off by virtually any undesirable change in the quality of water. 1/ It should be noted that most of the characteristics asked about in the Bishop survey are potentially pathogenic or a threat to the safety of someone making body contact with the water. It is not too surprising, therefore, to find that swimmers are highly sensitive to such characteristics.

- Tihansky and Jolly (1974) found at least a subtle direct relationship between specific water quality parameter improvements (in D.O., pH and total dissolved solids) and water-based recreation activities. (The relationship associated with fishing activities was much stronger.) 2/

- For activities other than fishing, no one has identified a relationship between water quality parameter measurements and recreation participation behavior in a quantitative manner. 3/

The above cited research indicates that recreationists perceive those water quality characteristics most which can be smelled or seen. More important is the degree to which "dirty" water is perceived as a negative influence over other pollution conditions. This is perhaps due to their limited knowledge of actual conditions or psychological factors. These different perceptions of the problem of pollution in water used for recreation lead to various responses, including changes in travel behavior, by the participants. These responses are discussed in greater detail in following sections of this report.

1/ Bishop and Aukerman (1970), op. cit., p. 90.
2/ Tihansky, Dennis P. and Willis G. Jolly, "Multiphase Demand Analysis of Recreation and Water Quality", U.S. Environmental Protection Agency, Program Element # 1B1030-20AAB, Unpublished study, 1974.
3/ Gutnamis, et al (1975), op. cit., p. 54.

Table 12

PERCENTAGE OF SWIMMERS REPORTING THAT VARIOUS INCREASED AMOUNTS OF SELECTED WATER CHARACTERISTICS WOULD CAUSE THEM TO STOP USING THE SITE

Characteristics	Percent Who Would Stop if Little More Unclear	Percent Who Would Stop if Moderately More Unclear	Percent Who Would Continue Using the Site
Unclear water	48.9	15.6	30.3
Dirty water	34.0	17.9	37.4
Odor of water	41.3	16.1	29.8
Color of water	21.6	8.4	60.5
Algae	31.6	19.1	34.2
Dead fish	62.3	15.1	9.5
Litter, debris	51.4	18.9	13.6
Weeds, plants	40.3	14.3	38.1
Fertilizers	29.6	7.4	23.3
Soap, detergents	29.1	18.7	23.5
Mud, silt in water	47.6	17.1	31.7
Sharp stones	45.8	14.6	31.2
Broken glass	66.7	0.0	16.7
Oil, grease, gasoline	48.5	24.0	10.5
Insecticides	44.4	11.6	10.9
Chemicals	56.1	16.2	7.5
Bacteria	69.4	10.4	7.8
Sewage	70.9	7.8	2.6
Manure	70.8	8.3	8.3

Source: Bishop and Aukerman (1970), op. cit., p. 82.

Table 13

SUMMARY OF CHARACTERISTICS THAT HAVE HIGH, MEDIUM, AND LOW PROBABILITIES OF CAUSING DIFFERENT RECREATIONISTS TO STOP USING SITES

Characteristics	Swimmers	Boaters	Fishermen	Sightseers
High Probability	Unclearness Dirtiness Odor Algae Dead Fish Litter Weeds, Plants Mud, Silt Stones Broken Glass Oil,Grease Insecticides Chemicals Bacteria Sewage Manure, Wastes	No data	Dead Fish Litter Fertilizers Soaps, Detergents Mud, Silt Oil, Grease Insecticides Chemicals Bacteria Sewage Manure, Wastes	Odor Fertilizers Sewage Manure, Wastes
Medium Probability	Color Fertilizers Soaps, Detergents	Odor Litter, Debris Weeds, Plants Mud, Silt Oil, Grease Insecticides Manure, Wastes	Unclearness Dirtiness Odor Algae Weeds, Plants Stones	Unclearness Dirtiness Dead Fish Litter Soaps, Detergents Mud, Silt Chemicals
Low Probability		Unclearness Dirtiness Color Algae Dead Fish Fertilizers Soaps, Detergents Stones Broken Glass Chemicals Bacteria Sewage	Color Broken Glass	Color Algae Weeds, Plants Stones Broken Glass Oil, Grease Insecticides Bacteria

Source: Bishop and Aukerman (1970), *op. cit.*, p. 89.

Table 14

OPEN-RESPONSE DESCRIPTIONS OF THE WATER BY SWIMMERS (Percentages)

Favorable Descriptions	(N=218) Swimmers	Unfavorable Descriptions	Swimmers
Clear	11.5(6)	Unclear	11.9(5)
Clean	33.9(1)	Dirty	22.5(3)
Pleasant Temperature	20.2(4)	Unpleasant Temperature	2.4
Attractive Color	0.4	Unpleasant Odor	2.4
Smooth, Calm	5.5(7)	Unattractive Color	1.4
Large Lake	1.4	Muddy	30.3(2)
Deep	2.8(10.5)	Littered with Debris	0.5
Not Stagnant	3.2(9)	Too Much Algae	2.4
Scenic	1.4	Too Many Weeds, Plants	0.0
Fresh	4.1(8)	Murky	1.4
Relaxing	0.5	Too Shallow	2.8(10.5)
Good Fishing	0.5	Polluted	0.5
Safe	1.8	Slimy, Scum	0.5
Not Crowded	0.5	Too Crowded	1.8
Spring Fed	0.0	Rough	0.0
No Weeds	1.0	Too Small	0.0
Good Size	0.5	Stagnant	0.0
Food Facilities	1.0	Dangerous	0.5
Well Maintained	0.5	Has Wastes, Sewage	1.4
Convenient	0.0	Foamy	0.0
No Obstructions	0.0	Poor Fishing	0.0
Shady	0.0	Many Bugs	0.0
Percentage of Descriptions Given That Were Favorable	51.9	Percentage of Descriptions Given That Were Unfavorable	47.3
		Neutral Descriptions	4.1

Note: Numbers in parentheses are ranks of characteristics in terms of frequency of mentions.

Source: Bishop and Aukerman (1970), op. cit., p. 37.

Table 15

OPEN-RESPONSE MENTIONS OF FEATURES OF A LAKE SITE BY SWIMMERS
(In Percentages)

Attractive Feature	(N=167) Swimmers	Unattractive Feature	(N=14) Swimmers
Water Characteristics	31.7(2)	Water Characteristics	71.6
Natural Surroundings	29.4(3)	Natural Surroundings	21.8
Facilities and Manmade Surroundings	20.4(4)	Facilities and Manmade Surroundings	28.0
Opportunities for Specific Activities	14.3(5)	Lack of Opportunities for Specific Activities	0.0
Generally Attractive or Pleasant	34.1(1)	Generally Unattractive or Unpleasant	21.8

Note: The various features are independent, not mutually exclusive; each respondent could mention more than one attractive feature, so the percentages in a given activity group do not necessarily add up to 100. N is the number in each group who first said the lake site was attractive.

Source: Bishop and Aukerman (1970), *op. cit.*, p. 43.

Table 16

OPEN-RESPONSE MENTIONS OF WHAT IS LIKED MOST AND LEAST ABOUT THE WATER BY SWIMMERS

(In Percentages)

What Is Liked Most	(N=218) Swimmers
Clear	7.3(7.5)
Clean	21.1(2)
No Odor	6.4(10.5)
Warm Temperature	14.7(4)
Cool Temperature	7.3(7.5)
Largeness of Lake	5.5
Deep	3.2
Unpolluted	6.4(10.5)
Convenient	10.1(6)
Simply the Presence of Water	6.9(9)
Natural Surroundings	3.2
Availability of Activities, Facilities	29.8(1)
Generally Attractive or Pleasant	15.1(3)
Other	11.9(5)

What is Liked Least	(N=218) Swimmers
Unclear	11.0(2)
Dirty	20.6(1)
Poor Bottom Quality	6.9(3)
Odor	3.7(7.5)
Temperature	1.9
Too Small	4.1(4.5)
Too Shallow	3.8(6)
Weeds, Algae, Plants	1.8
Other Pollutants	4.1(4.5)
Surroundings	0.5
Lack of Activities, Facilities	3.7(7.5)
Generally Unattractive, Unpleasant	2.8(9)
Other	2.3(10)

Note: The various features are independent, not mutually exclusive; each respondent could mention more than one feature that was "liked most, or "liked least."

Source: Bishop and Aukerman (1970), op. cit., p. 46.

Table 17

PERCENTAGE OF SWIMMERS REPORTING THAT THEIR USE OF THE SITE HAS DECREASED BECAUSE OF SELECTED WATER CHARACTERISTICS

Characteristic	Use Decreased	Use Not Decreased
Unclear Water	19.5	62.4
Dirty Water	21.8	53.0
Odor in Water	13.3	55.0
Color	10.9	71.4
Algae	7.5	71.6
Dead Fish	16.3	61.2
Litter, Debris	13.9	56.9
Weeds, Plants	12.7	66.7
Fertilizers	0.0	55.5
Soaps, Detergents	5.2	47.8
Mud, Silt in Water	12.2	74.4
Sharp Stones	18.2	61.4
Broken Glass	30.4	39.1
Oil, Grease, Gasoline	17.3	55.3
Insecticides	6.1	49.9
Chemicals	9.1	63.6
Bacteria	14.7	61.3
Sewage	20.0	54.3
Manure	8.3	66.6

Source: Bishop and Aukerman (1970), op. cit., pp. 77-80.

Characteristics of People Who Swim

Various kinds of surveys have been made of water-oriented recreationists. The determination of social and economic characteristics of the survey population is standard practice. Consequently, there is a fairly good base available indicating the kind of people who enjoy or are able to enjoy swimming and beach outings, and how they perceive and react to pollution. By understanding these characteristics, further insight can be gained into what kind of people are more likely to have been diverted from polluted beaches and who may return as a result of water quality improvement.

The major characteristics of recreationists shown to influence their activities and perceptions include income, education, occupation, group composition, age, and point of origin. Table 18 illustrates selected relationships between socioeconomic characteristics and swimming participation, and which are briefly discussed below.

Education: Evidence indicates a positive relationship between education and the tendency to participate in water-based recreation. A study of the residents of Green Bay, Wisconsin, showed that "eighty-six percent of those people with some college education were participants in water-based recreation, compared to fifty percent among those who had not completed high school."[1]

Income: Another study found a correlation between income and swimming participation. As Table 19 indicates, the likelihood of participation in swimming increases with an increase in total family income.

A study of Sand Beach, Rhode Island, made use of a relative social index based upon education, income and occupation.[2] Their study revealed that the greatest percentage of users fell in the middle and lower groups. However, the higher status group of people represented only 25 percent of the total sample. Thus, these statistics could be interpreted as a local phenomenon of numbers rather than a tendency to participate.

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[1] Ditton and Goodale (1972), op. cit., p. 98.

[2] Spaulding, Irving A., Factors Related to Beach Use, Sea Grant Marine Technical Report Series No. 13, University of Rhode Island, Kingston, Rhode Island, 1973, 20 pp (NTIS COM-74-10588).

Table 18

SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS OF SWIMMING PARTICIPANTS

	Other Swimming Outdoors		
Socioeconomic Characteristics	Percent Participating	Percent of Participants	Activity Days per Participant
Sex			
Males	33.2	47	9.4
Females	34.3	53	8.8
Age			
12-17	56.7	26	11.2
18-24	47.0	21	9.3
25-44	41.8	38	8.1
45-64	17.5	14	8.0
65 and over	4.4	2	8.1
Place of residence			
Not in SMSA	28.9	32	10.8
In SMSA	36.7	68	8.3
Family Income			
Under $3,000	14.7	4	8.3
$3,000-$5,999	24.5	11	8.6
$6,000-$7,999	30.1	14	8.6
$8,000-$9,999	34.7	17	8.3
$10,000-$14,999	39.4	27	8.1
$15,000-$24,999	43.5	18	9.5
$25,000-$34,999	57.3	5	16.0
$35,000 and over	51.0	3	13.4
Education			
8 years or less	25.9	39	8.4
High school	39.7	40	9.1
College	41.6	20	10.4
Race			
White	35.8	90	9.6
Nonwhite	22.8	10	4.6
Census Region			
Northeast	43.4	33	10.1
North Central	25.4	21	7.3
South	32.2	29	8.8
West	36.1	17	9.8

Source: Outdoor Recreation: A Legacy for America, Appendix "A", An Economic Analysis, United States Department of the Interior, Bureau of Outdoor Recreation, December 1973.

Table 19

RELATIONSHIP OF PARTICIPATION IN SWIMMING AND INCOME

Total Family Income	Do You Participate in Swimming?	
	Yes	No
$0-$3,000	22.6%	77.4%
$3,000-$5,000	34.1	65.8
$5,000-$8,000	56.1	43.9
$8,000-$10,000	76.1	23.9
$10,000-$15,000	89.0	11.0
$15,000 and over	89.7%	10.3%

Source: Ditton and Story (1969), *op. cit.*, p. 18.

Occupation: The literature indicates there may be a positive relationship between occupation and the tendency to participate in water-based recreational activites. The study of the residents of Green Bay, Wisconsin, showed the following proportion of participants by occupational grouping.[1]

Managers, officials, and proprietors	88.5%
Professional and technical	86.5
Clerical workers	72.0
Farmers	52.5

This relationship may be a function of financial capability, but could also be affected by such factors as proximity, percentage of each occupational category in an area, and individual needs and desires.

Race: It appears that lower income, nonwhite residents statistically are: (1) less likely to participate in nonpool swimming and engage in fewer activity days per participant than whites, as seen in Table 18. However, improvement in urban beaches near inner city areas will benefit those populations, as will be discussed later.

Group Composition: There appears to be a relationship between participation in water-based recreation and the composition of a group of people. The study on Sand Beach showed that the "groups" found there ranged in size from one person to nine or more. Furthermore, approximately 82.5 percent of the groups consisted of combinations of two to five people, and over half of the groups studied were family groups. Other groups found were based on either an institutional nature or friendship.[2] Myles (1970) also found visits to beaches at Lake Tahoe to be largely in groups of two to five people, as shown in the text table on the following page.

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[1] Ditton and Goodale (1972), op. cit., p. 98. Figures indicate percent of respondents who participated in swimming, boating or fishing during the the previous 12 months.

[2] Spaulding (1973), op. cit.

Total People in Group	Percent Answering			
	Cave Rock	Sand Harbor	Hidden Beach	Average
1	15	5	2	7
2	27	20	39	29
3	12	14	23	16
4	18	19	14	17
5	15	16	10	14
6	5	10	2	6
7	0	7	4	4
8	0	5	2	2
9	5	2	0	2
10 or more	3	2	4	3

Source: Myles (1970), op. cit. p. 9.

Age: The relationship of age to participation in water-based recreation appears to be reversed, with a decline in participation with increasing age. Again referring to the study of Sand Beach, the average ages tended to concentrate in the range of 17 and 25 years.[1] The study of Green Bay revealed that in the 18-34 age groups, 89 percent of the sample participated in fishing, boating or swimming at least once during the previous 12 months, while the 55 to 64 age group and 65 and over age group showed 64 percent and 40 percent participation, respectively.[2]

Specific water-based activities are also affected by age as shown in another study of Green Bay. The findings revealed that participation in swimming and fishing was most intensive from the 18 to 24 age group, while boating participation was heavier with the 25 to 44 age group.[3] These differences in age and activities may be a reflection of physical capability to participate and the financial capability to own certain equipment such as boats.

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[1] Spaulding (1973), op. cit., p. 4.
[2] Ditton and Goodale (1972), op. cit., p. 97.
[3] Ditton, R. B. and Per K. Johnson, Water Quality Perception and the Recreational Uses of Green Bay: The School Age Population. Sea Grant Grant, University of Wisconsin, 1971, p. 1.

Point of Origin: Another characteristic of those who participate in water-based recreation is their point of origin. Generally, local beach users tend to go to the nearest beach that fulfills their desired recreation experience; however, a large part of the current literature reveals that the greatest percentage of beach users are not from the immediate area surrounding the water base. In the case of Cape Cod, it was found that 70 percent of the visitation to the beaches is made up of vacationers and other longer term visitors.[1] Another study shows the vacation sector comprises approximately 80 percent of Lake Superior Basin's total effective population.[2]

These findings indicate that there is a willingness to travel some distance to participate in an acceptable water-based recreation experience. This should not, however, be misinterpreted that proximity is unimportant. Where water quality affects beaches near inner city areas, the impacts on less mobile, lower income individuals is particularly evident.[3]

Seemingly conflicting locational implications have also been identified. For example, one study found that more affluent and educated people lived in the vicinity of polluted beaches,[4] while another found that income and education characteristics of residents close to affected beaches to be below national averages.[3] These were studies of selected metropolitan areas, and illustrate the diversity of conditions which can exist within and around metropolitan areas.

The evidence is clear, at least from a statistical standpoint, that the propensity to swim and use beaches for recreation increases with higher incomes, the amount of education and higher occupational skills. Blacks and other nonwhite people also participate less, more as a relationship to being disadvantaged economically and educationally, and jobwise in larger cities rather than from ethnic or cultural differences.

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[1] Hecock, R.D., " Recreation Behavior Patterns as Related to Site Characteristics of Beaches", Journal of Leisure Research, Vol. 2, No. 4, Oklahoma State University, Stillwater, Okla. 1970, p. 242.
[2] U.S. Bureau of Outdoor Recreation (1970), op. cit., p. 26.
[3] Moore, et al (1975), op. cit., p. 103.
[4] Roberts, et al (1973), op. cit.

Thus, it is probable that a major component of the diverted beach user population referred to earlier are going to be affluent, well educated and white. Other characteristics of this diverted user group will be discussed in following sections of this report.

Factors Influencing Beach Selection

The characteristics of people who may be affected by water pollution have been discussed above. Now we will explore what kinds of activities water pollution affects and the choice of activity site (beach).

There are three categories of activities that are generally associated with the recreational use of water. The first category is contact activities such as swimming and water skiing, in which the participant is in direct contact with the water. There are also limited contact uses which include activities such as boating and fishing. The third type is non-contact uses in which no actual contact with the water occurs. Examples of non-contact uses include enjoyment of viewing the water and the surroundings, hiking, driving, camping, and picnicking. These last activities do not involve the direct use of water resource but are greatly enhanced by its presence. Thus, it is the aesthetic aspect of the water that gives the "added flavor" of these activities.

The three categories of water-based activities are each susceptible to influences from varying kinds and degrees of pollution. Also, the sensitivity of the participants to pollution determines their degree of contact with the water to participate in recreation. This, in turn, affects their decision on the location of a suitable beach site.

It has been shown that people do indeed select water-based recreation activity according to personal preferences and characteristics. Let us now explore the factors which influence the selection of the location or site at which they will participate. By assessing these relationships, insight can be gained to measuring the impact of pollution on preferred sites. The most significant factors revealed which influence the selection of site for water-based recreation include aesthetics, characteristics of the area, crowding, proximity and water quality. Other factors are also discussed below.

Response to Water Quality: There are a variety of observations on swimmer's responses to water quality contained in the literature. These may be summarized as follows:

- Water quality influences beach site selection principally when a significant pollution problem occurs.

Although water quality is a factor in site selection, a review of the literature found that, in general, people involved with water-based recreation do not frequently mention polluted water conditions as a major influence in site selection.

A survey by Spaulding (1973) of a natural remote beach (Sand Beach) near Narragansett Bay in Rhode Island found no mention of clean or unpolluted water or other water or beach quality parameter as a reason for visiting that particular beach, as illustrated in Table 20.[1] However, the beach is one of natural beauty, and has many aesthetic and convenience qualities. While no precise question in the survey was aimed at gleaning a response toward absence of pollution, it would appear that the high level of environmental quality at the site was an assumed, but significant factor in its selection.

The study of recreation perceptions at Green Bay, Wisconsin, however, showed that swimmers were more likely to report "clean water" as the factor influencing site selection than were fishermen and boaters. This further suggests that beach users (actual on-site) are a useful group to survey for pollution response because they have shown the desire to continue to participate in water-based activities at the expense of additional travel.

The exception to this general relationship is where a significant pollution incident has occurred and which resulted in a significant alarm for public health or safety. Such an incident occurred in a 1976 pollution of beaches on Long Island, as discussed in a case history later in this report.

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[1] Spaulding (1973), op. cit.

Table 20

ATTITUDES ASSOCIATED WITH VISITING A NATURAL, REMOTE COASTAL BEACH
(Sand Beach, Rhode Island)

Ranked Reasons for Selecting Beach	Percent
Beach not crowded	30%
Been here before	16
Personal feelings	12
Beach recommended	11
Other reasons	8
Natural environment	8
Exploration	6
Policies of management	5
Nearness to beach	4
Total	100%

Characteristics of Beach Liked Most	Percent
Parking	23%
Physical characteristics	22
Nothing	18
Swimming	10
Lack of concession facilities	10
Other	9
Trip to beach	7
Weather	1
Total	100%

Reasons for Going Back to Beach	Percent
Weather	26%
Personal feelings	25
Other	15
Break in work	11
A planned event	10
Interpersonal influences	5
Routine activity	4
Repeated but not routine activity	3
Beach is nearby	1
Total	100%

Factors Encouraging Beach Use	Percent
Personal feelings	26%
Contrast from city	16
Beach characteristics	13
Other	10
Weather	9
Nearness of beach	9
No work	6
Interpersonal influences	5
Access to beach	4
No cost	2
Total	100%

Factors Limiting Beach Use	Percent
Work and time	34%
Distance to beach	17
Transportation and traffic	12
Weather	12
Crowds	10
Other	6
Costs	3
Nothing	3
Access to beach	1
Interpersonal influences	1
Personal feelings	1
Total	100%

Beach Activities	Percent
Passivity	42%
Swimming	26
Walking	10
Reading	10
Other	6
Eating	3
Talking	2
Enjoys scenery	1
Enjoys sounds	1
Total	100%

Table 20
(Continued)

Greatest Benefits from Beach Use	Percent
Involvement with natural environment	45%
Sensory experience	29
Other	3
None	2
Physical movement	10
Characteristics of location	11
(space 6)	
(cleanliness 4)	
(proximity 1)	
Total	100%

Time and Distance Traveled to Beach	Percent
Miles traveled:	
0-12	39%
13-52	45
53-97	12
98 or more	4
Time traveled:	
Less than 1/2 hour	24
1/2 to 1-1/2 hours	57
1-1/2 to 2-1/2 hours	14
2-/12 to 7-1/2 hours	5

Rank (Descending) of Factors Upon Which Beach Use is Critically Contingent

Work and time
Weather conditions
Personal feelings
Distance
Transportation and traffic
Contrast between the city and the beach
Physical characteristics of the beach
Costs
Interpersonal influences
Nearness and accessibility

Source: Irving A. Spaulding, Factors Related to Beach Use, Sea Grant Marine Technical Report Series No. 13, University of Rhode Island, Kingston, Rhode Island, 1973, 20 pp. (NTIS: COM-74-10588).

In the Long Island case, public health agencies temporarily close beaches when material which looked like raw sewage washed up on the beaches. Official announcements were also made for people who had come in contact with the water to obtain vaccinations as a precaution. The material was soon determined not to be sewage and within 10 days the beaches were opened again, and most of the material and other debris had either decomposed or been cleaned up. However, beach attendances remained low because of the lingering fear of contracting disease as previously warned by local public health officials. Only after an intense public promotion effort to assure people that the beaches were now safe did beach attendance build back up to normal summer levels.

The implication of the Long Island example is that while quality conditions may not, in general, be a significant consideration in beach location selection, it may be a major consideration if conditions are bad or perceived to be unhealthy or hazardous.

- Demand increases with improvement in water quality.

As mentioned above, the deterioration of water quality at a beach makes some people travel to another cleaner beach. The improvement of water quality at a beach will result in increased use. The concern of this study is the rate at which (and what kind of) people use a beach under given kinds and degrees of pollution, and the rate at which they will return if the polluted conditions are improved.

In further accounting the costs and benefits of these effects, there are two sides to the question: The additional travel resulting from diverting from a polluted beach can be counted as a cost; or conversely, the "reduction" of travel costs by returning to a closer, improved quality beach may be counted as a "savings" benefit to the beach user, but not necessarily to the original beach.

An extrapolation of the Bureau of Outdoor Recreation beach attendance figures estimated that the percent increase in swimming activity days for each one acre increase in useable capacity ranged from a low of of 17 percent, to a median of 63 percent, to a high of 71 percent.[1] There is still not available empirical data which illustrates divergence from a beach when it becomes increasingly polluted. Some researchers, in a sense, have backed into the problem by attempting to estimate the amount of increased use when a polluted beach is improved (rather than measuring decreased use, and thus travel divergence, from increasing pollution), and thereby develop a coefficient for "willingness to travel."

When a polluted beach is cleaned up, the supply of useable beach is increased and an increased use (demand) results. Additional beach use is of three general kinds:[2]

- An increase in the number of visits by present patrons of the previously poor quality site.
- An increase in the number of new participants of two types:
  a. Those old users who are now returning; and
  b. New visitors, such as tourists.

Some have assumed that demand should increase at the same relative rate with respect to the degree of pollution control and number of beaches opened, provided supply of accessible beaches is adequate.[3] This suggests that a change in beach capacity yields the same relative increment in demand, based upon peoples' willingness to travel additional miles to avoid polluted water. However, this assumption does not account for the reluctance of longer distance beach visitors to change from a new beach site being once diverted to that site. This is particularly true of longer distance travelers who have been diverted from a polluted urban beach to a higher quality rural location. The Erickson assumption may hold accurate for urban beaches and local affluent visitors.

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[1] Erickson, R.K., Valuation of Water Quality in Outdoor Recreation, forthcoming Ph.D. dissertation, Department of Economics, Colorado State University, Fort Collins, Colorado (1975).
[2] Tihansky (1974), op. cit., p. 338.
[3] Erickson (1975), op. cit., p. 87.

- Nonbeach users demonstrate a greater propensity to change a beach site due to increased pollution than do on-site beach users.
- Half of householders who change beach sites due to increased pollution would still seek another place to swim.

Studies have indicated that if the recreational experience fails to meet a persons' expectation due to undesirable or polluted water conditions, a person may react in the following ways: (1) one may return due to cost and time factors and accept an inferior experience, or (2) one may not return, thereby diminishing the social and economic value of the site. The latter reaction presents two additional alternatives. Either the person may stop participating in the activity altogether, or perhaps select another activity, or he may shift his location of use.

The study of Green Bay (household interviews) further supports these reactions to polluted water. Respondents were asked for their reaction to deteriorated water conditions. It was found that while a small percentage would not change their activity, a fairly large percentage of respondents would "give up" the activity, as summarized in Table 21. Another notable point is the percentage of respondents who would move to another location to participate in the activity. For each activity, at least 50 percent said that they would react in this manner.

Again, however, the Green Bay reactions were those of households rather than on-site beach users; this would tend to explain the readiness to change beach sites. There are also many other alternative beaches along Lake Michigan and other nearby inland lakes.

Field (1973) further demonstrated that for visitor to beaches, lakes and rivers that: 1/

- social involvement is a strong factor in the visit;
- leisure activities at these locations were easily interchangeable, particularly if the site offered a variety of recreation opportunities; and

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1/ Field, Donald R., Sociological Dimensions of Leisure Involvement in Water-Based Recreation, College of Forest Resources, University of Washington, Seattle, Washington 98195 (NTIS PB-223-349); July 1, 1976, 43 pp.

Table 21

RESPONSE IF WATER CONDITIONS DETERIORATED AT AREA USED MOST FREQUENTLY FOR FISHING, BOATING, AND SWIMMING GREEN BAY, WISCONSIN

	Would Not Bother Me (percent)	Stay in Same Location but Participate Less Frequently (percent)	Move to a Location on Green Bay (percent)	Move to a Location Not on Green Bay (percent	Stop Participating Entirely (percent)
Fishing					
Green Bay	5.5	8.3	22.4	31.9	31.1
Lake Michigan	1.4	4.1	7.5	56.8	30.1
Inland Lakes	2.4	10.8	4.1	63.9	18.3
Streams and Rivers	4.0	8.4	4.4	62.4	20.4
Boating					
Green Bay	13.5	14.8	18.4	30.6	21.7
Lake Michigan	8.6	2.9	5.7	54.3	25.7
Inland Lakes	4.5	15.5	5.8	55.3	17.2
Streams and Rivers	3.0	20.8	7.9	38.6	28.7
Swimming					
Green Bay	2.4	7.8	20.4	43.7	25.1
Lake Michigan	.0	6.3	12.2	43.8	37.5
Inland Lakes	2.6	9.5	2.2	66.2	18.7
Streams and Rivers	3.5	12.9	.0	55.3	28.2
Pools	5.0	8.1	6.3	55.4	24.3

Source: Ditton, Robert and Thomas Goodale, Marine Recreational Uses of Green Bay. A Study of Human Behavior and Attitude Patterns, WIS-SG-72-217. University of Wisconsin 1972, p. 94.

- similar groups participate in like activities in various leisure settings.

For example, 97 percent of beach users surveyed at beaches, lakes, and rivers were engaged in their leisure activity within a group, as follows:

- alone, 3 percent,
- with friends, 20 percent,
- family, 50 percent,
- family and friends, 26 percent,
- other, 1 percent.

Fields' findings would tend to suggest that if a group traveled to a beach and found the site polluted, they would tend to stay and substitute some other group interaction activity for, let's say, swimming. This would be even more probable if the beach site offered other related recreation activity opportunities.

However, Fields' findings provide no evidence to suggest the social group influence would inhibit a change in beach trip if the group was aware of the polluted beach condition prior to the trip. It would appear that a substitution of either an alternative beach site could easily be made if it were available, or a substitute activity could be made to pursue group interaction.

- Social and economic circumstances influence beach site selection.

A study of water-based recreation users in the Boston and Seattle metropolitan areas also found the following reactions to beach site quality.[1]

- In general, the percentage of people who wanted cleaner beach sites varied inversely with the quality of the site (except for lower quality fresh water lakes in Boston).

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[1] Roberts, et al (1973), op. cit., P., II-113-114
Note: Willingness-to-pay data collected by telephone interview and travel distance data collected by on-site interviews.

- Lower income classes are more likely to ask for site improvement (clean-up) than upper income classes; and conversely, upper income people are likely to not have suggestions about how to improve the site they are using. The difference appears to be due to site use, with poorer people using the worse site.

- People at better quality beaches indicate a higher concern for quality and may be expected to travel further to maintain beach quality. They also reflect a higher socioeconomic status of the ratio of convenience use by nearby residents.

- The primary reasons for going to lower quality in-city beaches are convenience, social/family reasons.

- Longer travel distances lead to somewhat less frequent use, but influence less in higher socioeconomic groups. 1/

Also, a review of socioeconomic characteristics of swimmers shows that improvement in beach quality would tend to benefit:

- Younger individuals and families;
- Individuals and families with middle income;
- Individuals and families with higher educational attainment; and
- Primarily urban beneficiaries.2/

Crowding: The effect of crowding also influences the choice of a site for water-based recreation. The frequent response that a particular site is "not too crowded" lends evidence to support this. However, teenagers and college students react positively to crowding and sometimes thrive upon it.3/

Smith (1975) discusses how meaningful indices of congestion may be developed. He cites Stankey (1972) as an example of attempts

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1/ Roberts, et al (1973) Ibid., pp. II-101-108.
2/ Moore, et al (1975), op. cit., p. XIII.
3/ Hecock (1970), op. cit., p. 246.

to understand the effects and sensitivities to congestion and to adjust management policies accordingly. The problem is to isolate out the water quality factor from the variables that affect participation, and then further the travel associated with the problem

Aesthetics: The state of the art of aesthetic assessment has rapidly improved in recent years.[1] Now, aesthetics are highly measurable and predictable, and undoubtedly are a factor in site selection for water-based recreation.

Every person may have a particular aesthetic preference. Each preference is also determined significantly from the context within which it is viewed. There also appears to be evidence that a positive relationship exists between beaches that are high in natural beauty and the attraction of visitors with higher socioeconomic attributes.[2]

Characteristics of Surrounding Area: The characteristics of the immediate area are also factors in site selection. Such characteristics are stated by Hecock as being (1) rental costs, (2), number of nearby beaches, and (3) number of nearby lodging units.[3] Hecock also found that the presence of standard beach facilities such as clothes changing rooms, restrooms, and supervision play a huge role in average attendance, as summarized in the text table, following.[4] Food facilities were also found to be a major attraction of the teenage and college group.

	Beaches with Standard Facilities	Beaches without Standard Facilities
Average 2:00 p.m. Attendance	665	133
Beaches	Craigville, Dennis Orleans, Coast Guard Skaket, Race Point, Sandy Neck	South Beach, Cahoon's Hollow, Chapin

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[1] U.S. Environmental Protection Agency, Aesthetics in Environmental Planning, Office of Research and Development, 1973.
[2] Hecock (1970), op. cit., p. 248.
[3] Ibid., p. 243.
[4] Hecock (1970), op. cit., p. 245.

Access, Distance and Travel: The affect of marine pollution on recreation travel patterns depends on a variety of factors, such as:

- Proximity of alternative recreation areas;
- Duration and frequency of the pollution problem;
- Elasticity of recreation demand;
- Mode of transportation available.

A Report to the National Commission on Water Quality indicated improved water quality as a result of the Water Quality Act can be expected to produce savings in time and travel costs for individuals diverting to closer beaches made useable through water quality improvement.[1] Applying the example of the Lake Erie and Lake Ontario case, the improvement in beach quality may result in 40 percent of the increase in urban areas being new visitors, and 70 percent of the increase in rural locations being new visitors. The new visitors are largely people who have traveled longer distances.

The proximity of a beach within an urban or rural circumstance will also affect the response of recreationists to deteriorating or improved water quality conditions. In comparing Bureau of Outdoor Recreation estimates of increases in new beach visitors resulting from water clean-up efforts in Lake Erie and Lake Ontario, it was found that increased use would be comparatively greater in Lake Ontario as illustrated in the following text table.

	Anticipated Gains in Swimming Beyond Current Demand Resulting from Total Clean-up	Added Total of Beach (K/M) Space	Number of Increased Demand from New Visitors
Urban Lake Erie[2]	40%	65%	40%(urban)
Rural Lake Ontario[3]	60%	95%	70%(rural)

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[1] Moore, et al (1975), op. cit., p. III.

[2] U.S. Bureau of Outdoor Recreation, Water-Oriented Outdoor Recreation in the Lake Erie Basin, Ch. 9, Department of the Interior, Ann Arbor, Michigan, 1966. p. 9

[3] U.S. Bureau of Outdoor Recreation, Water-Oriented Outdoor Recreation in the Lake Ontario Basin, Ch. 6, Department of the Interior, Ann Arbor, Michigan, 1967, p. 25.

This appears to occur because the Lake Erie shoreline is more urbanized and industrialized and the beaches are less attractive to newcomers, that is, visitors who travel greater distances. New use, stimulated by improved water quality, will be attracted to the more pristine rural locations of Lake Ontario. Recreationists diverted to Lake Ontario by polluted beaches at Lake Erie may be reluctant to return to Lake Erie even after substantial clean up has occurred. The elderly and poor citizens living in the metropolitan areas around Lake Erie are relatively immobile, so they either tolerated the deteriorated beach conditions or sought other recreation alternatives.

The implication of the Lake Erie-Lake Ontario case study is that recovery of new beach users generally will be greater in improved rural beach locations than in urban locations.

Access and availability of transportation also affect a recreationist's ability to seek another clean beach or continue to tolerate a nearby beach of lesser quality. A report on recreation access by the U.S. Department of Transportation revealed the following significant findings.1/

- An estimated 90 to 98 percent of all persons trips to regionally significant recreation areas are made in private automobiles or private recreaction vehicles.
- From 6 percent to 25 percent of visitors to recreation areas within cities and urban fringes use public transportation facilities.
- The problems expressed regarding adequacy of public transportation services to recreation sites include:
    - poor schedules;
    - ineffective routes;
    - difficulty in carrying equipment;
    - travel experience not an enjoyable part of outing.

1/ U.S. Department of Transportation, Recreation Access Study, Summary Report transmitted to Congress August 22, 1975, by William T. Coleman, Jr., Secretary of Transportation, Washington, D.C. 20590 (17 p.).

- About 10 percent of the people surveyed cited transportation as their primary reason for not visiting a recreation place. Other reasons indicated include 50 percent, lack of interest; 20 percent, health or age; and 20 percent, personal reasons.

Indicated below are some insights pertaining to the relationship of beach site choice and distance traveled to the site revealed in the literature review:

- Lower quality beaches are used most by people who travel short distances.
- Better sites are used by upper income and educated people and attract people from longer distances. 1/
- Better sites in suburban areas tend to be in areas where upper income and educated people live. 2/
- Higher quality urban beaches are visited by a greater proportion of affluent and well-educated users who are willing to travel further in order to maintain a quality site. 3/

A site survey of Boston and Seattle concluded: " ... when one randomly samples recreation users, one finds more upper income and educated people at higher quality sites than at lower quality sites. On average, such individuals had travelled further than lower income/educated individuals. They had not travelled more than those lower on the socio-economic scale at the same site, but rather they had chosen different kinds of sites." 4/

Proximity to a beach influences site selection, especially as the distance from the point of origin decreases and the visit becomes more convenient. Distance is the primary cost factor associated with recreation travel.

1/ Roberts, et al (1973), op. cit., p. II-84, 126.
2/ Ibid., P. II-85.
3/ Ibid., p. 84.
4/ Ibid., p. II-90.

Distance is frequently used as a surrogate for travel cost. From an overall perspective, recreation travel costs involve distance traveled, time, inconvenience, monetary costs, and user fees. (User fees are generally small in proportion to other costs.) Per capita recreation (expenditures) of the site is then computed as a function of travel or distance-related costs. A demand curve for the site can be derived from this information. Smith (1975) summarizes the effectiveness of travel cost methodology as:

> ". . . . it may be useful to note that despite what may appear as a myriad of assumptions and a variety of unresolved estimation problems, the travel cost methodology appears remarkably robust. The estimated relationships generally exhibit quite respectable fits and statistically significant effect for travel cost, income, and taste measures. Moreover, there is consistency in the results across estimates of the demand parameters for similar facilities."

At the few large beaches that have been surveyed, longer term visitors from greater distances make up a larger proportion of beach users. As opposed to the smaller amount of local visitors, the distant travelers are more quick to change sites in response to degraded water quality. Moreover, once a change in beach site has been made, the longer range visitor is more likely to stay at the new alternative site rather than return to the previous beach when it has been improved.[1/]

Vacationers and longer term visitors comprise a larger percentage of beach users. However, a measurement of the distance from their place of lodging to the chosen beach might better relate proximity as a factor in site selection. Because even though vacationers travel some distance for beach recreation, they do not tend to travel very far from their accommodations to their chosen beach site.

[1/] Tihansky (1974), op. cit., p. 339.

Convenience is given as an important reason for visiting both clean and lower quality beaches by all income and educated classes.[1] While most recreationists prefer to visit clean beaches, polluted sites may be tolerated if they are particularly convenient and or accessible, especially by local residents.[2] Local residents are also quicker to return to a cleaned-up beach and constitute a greater percentage of increase in use.

The travel costs incurred in reaching the recreation site can also influence the response to water quality. If sufficient cost has been incurred in reaching the site, then conditions which might have been unacceptable in other circumstances may be tolerated due to sunk transportation costs. On the other hand, increasing transportation distances are usually associated with access to water of proportionally increasing quality (as pollution is often associated with urban centers).

Other factors which can influence recreation travel to beaches in addition to water quality conditions, include:

- Availability of alternative beach sites and multipurpose nature of recreation travel;
- Individual preferences;
- Seasonal variances;
- Length of stay (as distance related costs increase, there tends to be an incentive to lengthen the stay or enlarge the group.).

Summary of Factors Influencing Beach Selection and Travel: Based upon the preceding observations, some general observations or conclusions may be drawn. These conclusions are based primarily on extrapolating from site-specific and subject-specific research studies. While the reported findings in themselves generally made no effort to apply results to other situations or nationally, the pattern of perceptions, reactions and other data does present an overall picture from which at least some obvious working hypotheses can be derived. These are as follows:

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[1] Roberts, et al (1973), *op. cit.*, p. II-114.
[2] Tihansky (1974), *op. cit.*, p. 339.

- Most of the estimated three to eight percent of the national capacity of public beaches constrained by degraded water quality are of a temporary nature (less than one month).

- The improvement of water quality at presently degraded beaches through implementation of the Federal Water Quality Act would result in an estimated 1.2 to 2.7 percent increase in seasonal swimming and a relocation of 8 to 28 percent of the swimming activity.

- An improvement in water quality at a beach can result in savings in travel time and cost as visitors relocate back to the beach. In some instances, visitors may actually travel further to reach the newly clean beach than the beach they have been diverted to as a result of pollution, if it is a higher quality beach. No empirical data could be found measuring the actual characteristics of travel divergence patterns from a polluted beach or returning to cleaned-up beach.

- Lower quality beaches are used mostly by people who travel short distances.

- The proportion of new visitors to a cleaned-up beach will be higher at a rural location (e.g., 70 percent) than at an urban location (e.g., 40 percent).

- Up to one-quarter of the visitors to recreation areas within larger urban areas use public transportation facilities if they are available. When public transportation is available, divergence from a degraded beach to a clean beach is easy.

- Higher quality beach sites in urban areas are often located in upper income areas, and visited more by people of higher income and education.

- People with higher incomes and education travel further for a clean beach and are more quick to divert from a beach with deteriorating quality.

- Longer distance travelers make up a higher proportion of visitors at a larger popular beach with high attendance. Longer distance travelers are more apt to divert to another beach when their original beach has deteriorated in quality.

- Conditions of deteriorating quality at a beach will be tolerated longer by people who live conveniently nearby and those who are poor.

- Groups who visit a beach may tolerate longer a deterioration of beach quality if there are other substitute or alternative recreation opportunities through which personal group interaction may be maintained.

- While the aesthetic perception of water quality is generally the dominant factor influencing the selection of a beach and the level of enjoyment and water contact activity, the fear of public health hazard has the greatest impact on beach use curtailment and divergence once it is perceived. Furthermore, once a real health hazard has been perceived and before normal visitation will return, assurances must be given to the public that the beach is safe after the contamination problem is corrected.

- Travel costs associated with diverting to a clean beach is a factor of concern primarily to middle and upper income travelers on longer trips. Travel costs do not appear as a significant influence in lower income groups in beach site studies because poorer people, in general, simply do not visit a beach of any type.

What then, do the above observations reveal. First, they show that there is a lack of empirical evidence to connect overall national assessments of increases and relocation of swimming (thus beach use) due to improvement in water quality with the broad range of behavior/response research which has been directed toward determining how people respond to water quality improvement or degradation.

Second, they suggest that improvement in water quality may impact the relocation of swimming activity from 4 to 10 times as much as it will stimulate an overall increase in swimming activity. And thirdly, the data shows that the significant amount of pollution occurrences which cause divergence (or cessation) in beach seeking travel are temporary in nature.

At this point, two choices appear in proceeding with this study, One choice is to go back to the range of studies reviewed in the preceding sections and attempt to develop a statistical model which relates the various behavioral characteristics of swimming and beach users with the national figures for beach capacity, beach and swimming use, and impacts of improved water quality. While this kind of effort would be an interesting, scholarly pursuit, its applicability in terms of methodology or results, ERA believes, would be of limited value to those most directly impacted by water and beach pollution occurrences and for taking steps to improve such conditions.

The second choice, the one ERA has opted to pursue, is to use the above relationships as a basis for developing a practical method of estimating the economic impact of a pollution occurrence at a beach. Such a method would utilize known travel cost factors, and apply them to the visitation or attendance data available for the beach site subject to a pollution occurrence. This method would be available as a working tool for state and local agencies, organizations faced with having to take steps in response to a pollution occurrence in a particular location. This approach is presented in Section III.

Section III

MEASURING RECREATION TRAVEL COSTS RESULTING FROM MARINE POLLUTION

Pollution damages to recreation values of beaches represent a gain to the waste dischargers and a value loss to the recreationist. The amount of beach closures is directly related to the economic impact of marine water pollution on recreation. [1] Beach pollution and, worse, beach closures due to pollution, incur costs. It costs the local area revenue that would have been expended by tourists and visitors, and it costs visitors in loss of satisfaction or even denial of a recreation experience. In assessing either loss from pollution or benefits from ameliorating pollution, there is yet another cost that needs to be considered. This cost relates to the additional travel which a beach user undergoes in order to find a suitable clean beach at which to swim and enjoy. In order to measure the economic effects of alternative travel patterns due to marine pollution, it is first necessary to summarize other research related to the economic impact of recreation travel costs. Following this review, a case study situation will be analyzed, and a methodology for measuring these costs will be developed and tested.

The Economic Impact of Recreation Travel Costs

As mentioned in Section II, there is virtually no hard, empirically based data upon which to assess the total costs of this important component of the benefit and loss statement for water quality. Heretofore, water quality benefits have been computed without this weighted consideration.

Economic effects of beach closures due to pollution are of several types. For the local area, there is often the problem of the immediate loss of recreationists' expenditures and the reallocation of demand to alternative areas. Another major impact is on the recreationist who is forced, or chooses, to alter travel patterns, involving longer trips, reduced usage and possible inability to get to a beach if another transportation mode is required. The effect of marine pollution on recreation travel patterns will depend on a variety of factors such as: proximity of alternative recreation areas, duration and frequency of the pollution problem, elasticity of recreation demand, mode of transportation available, and many other factors.

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[1] Tihansky (1974), *op. cit.*

Tihansky's work[1] concentrated on assessing revenue losses due to marine pollution of beaches based upon expenditures and income lost from tourist and local visitors at the beach. No empirical data has been developed for increased travel cost of people seeking cleaner beaches. Another study by Batelle Columbus Laboratories inventoried beach closures and assessed potential increases in swimming at beaches that may occur as the result of improvement in water quality.[2]

As stated earlier, it has been estimated in the study for the National Commission on Water Quality that between three percent to eight percent of the national capacity of public beaches, measured in acres is presently constrained by degraded water quality; and, at the most, only about 86 percent of the polluted beaches may be improved by measures called for under the Water Quality Act.[3] Additionally, given the present rate of participation of seasonal recreational swimming, an increase of only 1.2 percent and 2.7 percent swimming participation could be expected if the increase in total useable beach capacity in acres were achieved.[4]

However, about 8 percent to 28 percent of present beach use is being diverted from initially preferred locations and may relocate once water quality has improved. This suggests that there may be a substantial saving in terms of dollars, time and fuel if beaches were improved to swimming quality.

It should also be noted that a large portion of the beach closings have occurred in larger metropolitan areas, especially in the Northeast, Great Lakes, California and Florida regions.[5] The amount of beach closures and polluted conditions found in the commission inventory shows a substantial decrease over the polluted conditions prevalent in the 1960s and reported in a 1972 EPA inventory of beaches.[6]

1/ Tihansky (1974), op. cit., pp. 334-342.
2/ Moore, et al (1975), op. cit.
3/ Moore, et al (1975), op. cit.
4/ Moore, et al (1975), op. cit.
5/ Moore, et al (1975), op. cit., p. 87.
6/ Brown, P. R., et al, National Inventory of Recreational Beaches Closed by Pollution - 1971, Plessey Environmental Systems, San Diego, 1972.

Two other recent studies sponsored by EPA dealing comprehensively with water quality and recreation benefit (and cost) did not address the specific relationship of travel costs resulting from beach pollution.[1][2] These studies are the most current in this general field of study. Additionally, review of the extensive bibliographies accompanying the reports failed to reveal further relevant sources.

Practically every survey estimates recreational losses as the total drop in attendance. However, this assessment is misleading since some recreationists might travel to other beaches, or perhaps substitute other activities for beach related sports. An analysis of recreational travel patterns in response to beach closures would reveal the magnitude of this impact. The costs of changing travel distances would measure some of the disbenefits from beach pollution. Such information is needed by policymakers in order to compare the costs and benefits of controlling waste discharges into lakes along coastlines.

Published estimates of recreational losses due to marine pollution are limited to a few beaches, which are among the most heavily visited in the United States. Several methods are used for translating these effects into economic welfare losses. Willingness to pay for recreactional opportunities is recommended from economic theory. A more popular approach is the travel cost approach, which assumes that travel expenses represent a minimal measure of willingness to pay. Although the latter measure does not reflect the intrinsic work or welfare of recreational demand lost at polluted beaches or transferred to another site, it is easily assessed from interviews. Travel patterns of water recreationists have frequently been studied, but never with respect to water quality problems.

Studies of the economic impact of recreation losses have been largely theoretical and based upon unvalidated assumptions. Sound empirical base information has been difficult to obtain because of the following reasons:

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[1] Roberts, et al (1973), op. cit.

[2] Reiling, S. D., K. C. Gibbs, and H. H. Stoevener, Economic Benefits from an Improvement in Water Quality, Office of Research and Monitoring, U.S. Environmental Protection Agency, 1973.

- Evaluation of recreation values involves many variables and consequently is complex and difficult;
- An extensive data base on the extent of marine pollution and corresponding beach visitation rates would be required and would be very expensive.
    - Values and benefits of recreation vary by geographic location, season, and different socioeconomic groups
- Double counting is difficult to account for, such as associated with travel cost, living expenses and property value changes. Other benefits may be conflicting, such as in the case of certain swimming and fishing encounters.

Tihansky has compiled published estimates of recreational losses due to marine pollution as shown in Figure 2. Most of these losses are limited primarily to public beaches.1/ Estimates of welfare impact of water pollution on public beaches range from $27.5 to $65.3 million in 1970.2/ Tihansky found in accounting recreation losses due to marine pollution that:

1. Most losses are limited primarily to public beaches along the nation's coastline.
2. Swimming is usually most sensitive to water contaminants and accounts for the majority of activity day losses. 3/

Estimates of recreation losses are derived normally by accounting associated expenditures or costs of recreationists. Net benefits are often assumed.

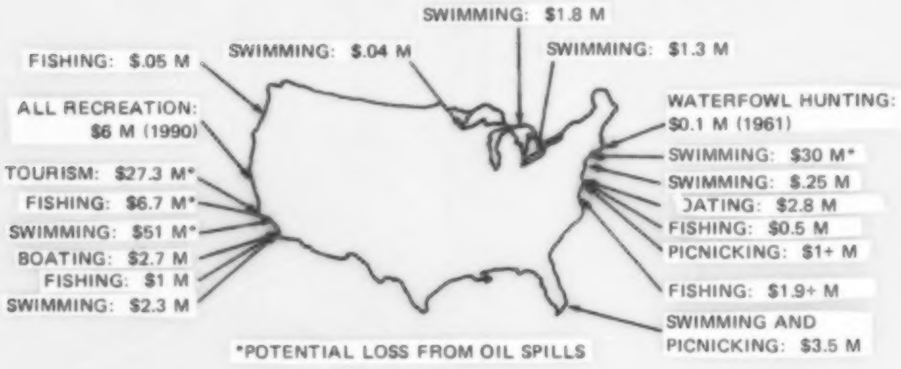
This rationale assumed expenditures indicate what the recreationists is willing to pay and costs are not incurred unless they at least represent a lower bound of potential benefits.

1/ Unless otherwise noted, values pertain to expenditures and income lost from tourists and local visitors. Some estimates, particularly along the Great Lakes shoreline, are based on foregone revenue of $2.00 per recreation day.

2/ Tihansky (1974), op. cit.

3/ Ibid., p. 337.

Figure 2
Documented Estimates of Annual
Recreation Losses from Marine Pollution, 1970


SWIMMING: $1.8 M
FISHING: $.05 M
SWIMMING: $.04 M
SWIMMING: $1.3 M
ALL RECREATION: $6 M (1990)
WATERFOWL HUNTING: $0.1 M (1961)
SWIMMING: $30 M*
TOURISM: $27.3 M*
SWIMMING: $.25 M
FISHING: $6.7 M*
OATING: $2.8 M
SWIMMING: $51 M*
FISHING: $0.5 M
BOATING: $2.7 M
PICNICKING: $1+ M
FISHING: $1 M
FISHING: $1.9+ M
SWIMMING: $2.3 M
SWIMMING AND PICNICKING: $3.5 M

*POTENTIAL LOSS FROM OIL SPILLS

This approach does not consider several important factors: (1) costs or expenditures do not measure adequately intangible values; (2) recreation expenditure and cost patterns will change under different circumstances given the same motivation and value received; (3) excess recreation costs over normal living costs reflect market values rather than recreational enjoyment; and (4) benefits could be less than costs.

To reconcile these inadequacies, economists have recognized "willingness to pay" as a valid measure of net welfare benefit or recreation value. The willingness to pay approach assumes a recreationist is willing to pay a certain amount for the enjoyment of beach facilities. What one is willing to pay is usually more than what is actually spent. In analyzing the willingness to pay approach, Roberts also found that:

- Income elasticity for willingness to pay is an "S" shaped function of income, with about 1.15 to 1.25 middle income range, and lower at higher and lower income ranges. 1/
- Over the middle income ranges, willingness to pay for environmental quality rises somewhat more rapidly than income 2/ and that
- Upper income and upper educated users are in general willing and or able to travel further to obtain higher quality recreation. 3/

Other factors may bias expressions of willingness to pay, such as the distance to be traveled to another clean beach site versus the cost of cleaning up the convenient nearby beach.

Difference between what the consumers are paying for recreation and what it is really worth to them is referred to as consumer surplus. The consumer surplus is considered to be theoretically a valid (at least widely used) measure of net benefits of recreation value. In estimating recreation value over travel costs, Tihansky identifies two types of costs resulting in a consumer surplus:

1/ Roberts, et al (1973), op. cit., pl II-54.
2/ Ibid., p. II-126.
3/ Ibid., p. II-126.

- Price equivalent, reflecting the amount of compensation a recreationist would be willing to accept (e.g., money saved) to yield his right to continue using an existing beach, and

- Price compensating reflecting the cost a recreationist is willing to pay for a new site.

To arrive at his estimates of net recreation benefits and damage losses due to pollution, Tihansky used a value factor (consumer surplus) of \$1.00-\$2.00 for swimming day for new participants and \$2.00-\$5.00 for current beach users (developed by BOR and others) and applied them to estimated increases in recreation activity resulting from water quality improvement.

Tihansky's figures are highly theoretical. The consumer surplus dollar values are anchored to empirical survey data which is still theoretically based, and the travel dispersion rates between urban and rural locations is based on BOR estimates which, in turn, were based in large part on assumptions of travel patterns. This work nevertheless appears to be the most carefully thought out measurement of marine recreation damages from pollution in the literature. It builds upon the best possible information available.

In summary, available research has focused on many of the issues involved in measuring travel related costs resulting from beach pollution. However, based on a thorough literature search, it has been concluded that no specific research has been conducted on the overall economic impact of marine pollution on the recreationist. To this end, the following case analyzes the affects of marine pollution on a particular area in terms of attendance and economic impact. Based on the conclusions of this case study and on the previously cited research, the final sections of this report present a generalized approach to measuring the impact of marine pollution on recreation travel costs.

Long Island Case Study

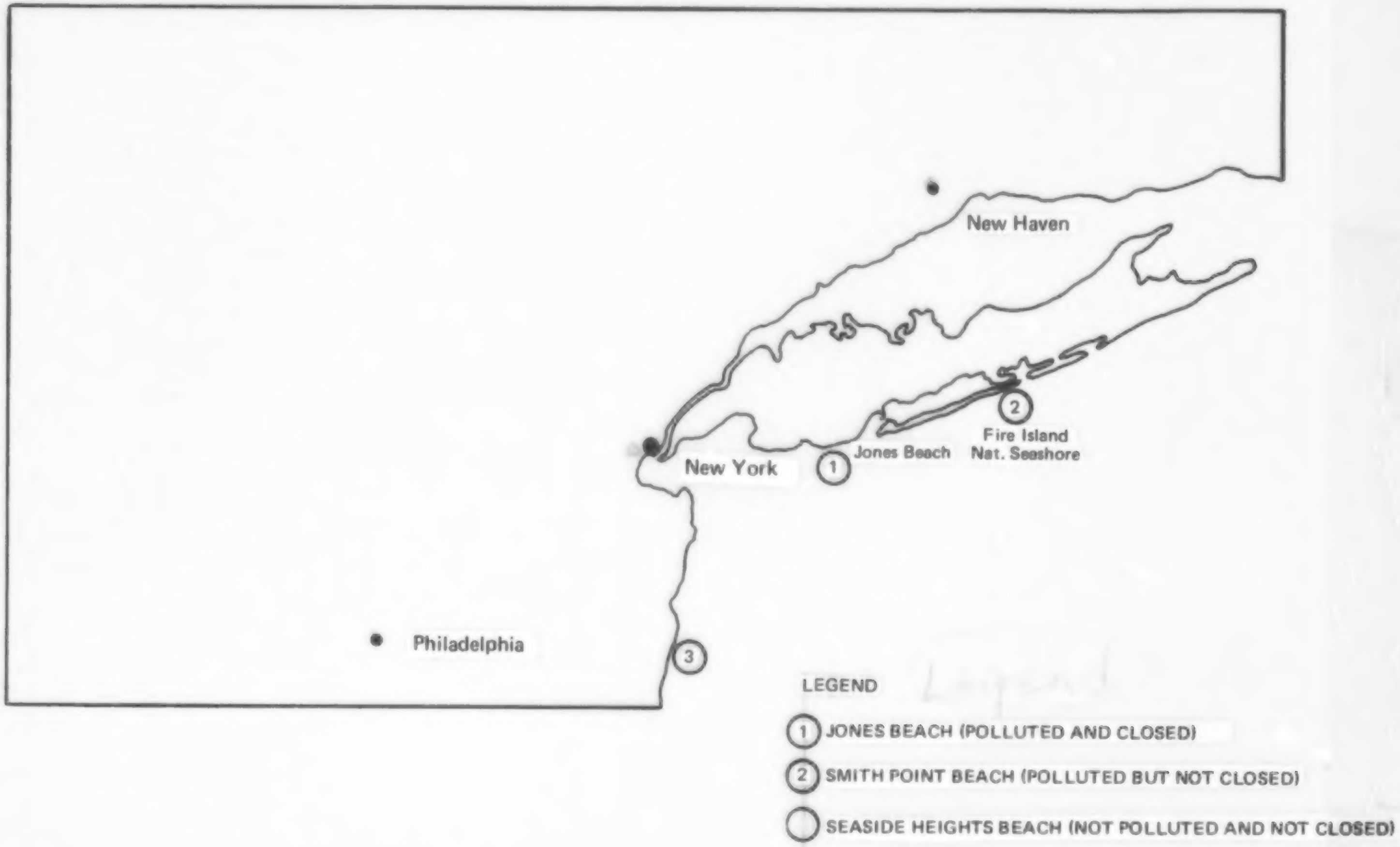
In selecting a case study area to evaluate the cost impact of marine pollution on recreation travel patterns, the following factors were considered.

- A recently polluted beach that was not closed for a significant length of time was needed in order to judge the divergence effect to alternative beaches.
- A polluted beach in relatively close proximity to non-polluted beaches was needed so that divergence effects could be easily measured.

After considering these factors, Jones Beach on Long Island was selected as an appropriate study area. This beach is one of the major swimming beaches serving the New York metropolitan area, and in June 1976 was closed for a two-week period due to high levels of marine pollution. Also, Jones Beach is located in relatively close proximity to alternative beaches that were not closed during this period as a result of the pollution. Two kinds of alternative beaches that were available to diverted beach users were analyzed, the locations of which are shown in Figure 3. Smith Point Beach, located on the eastern end of Fire Island and about 50 miles from Jones Beach, was relatively clean during the pollution period and was not closed. A more distant outlying clean beach was also surveyed, Seaside Heights in New Jersey, which is located about 100 miles from Jones Beach. Study of these alternative beaches will provide insight into short and long-range travel divergence (away from these beaches) due to the pollution impacts at the Jones Beach area.

The case study of the Jones Beach area is presented below. First, an attendance overview of the Long Island beach user is presented, in order to provide a basis for measuring the pollution impact. Next, the extent of marine pollution affecting Long Island in the summer of 1976 is reviewed, followed by an analysis of the impact of this pollution on attendance at the three study area beaches. Finally, conclusions derived from from the Long Island pollution experience are then reviewed, particularly as to the affect of this pollution on recreational travel patterns.

Figure 3
Location of Long Island Case Study Area Beaches
Impacted by Marine Pollution, 1976


New Haven
New York
Jones Beach
Fire Island
Nat. Seashore
Philadelphia
1
2
3
LEGEND
Legend
① JONES BEACH (POLLUTED AND CLOSED)
② SMITH POINT BEACH (POLLUTED BUT NOT CLOSED)
○ SEASIDE HEIGHTS BEACH (NOT POLLUTED AND NOT CLOSED)

Attendance Overview: Long Island beaches, including Jones Beach, Robert Moses Beach,[1] and Smith Point Beach, provide a major recreational resource for residents of Long Island and the greater New York metropolitan area. Characteristics of recreationists using Long Island beaches can be estimated based on data provided in a study prepared by the New York State Parks and Recreation Commission[2] as follows:

- In 1975, approximately 1.7 million persons participated in nonpool swimming on Long Island. Since the average swimmer participates 10.1 times per year, about 17.4 million person days of swimming occurred on Long Island.
- On the average summer weekend day, about 760,000 persons participated in nonpool swimming on Long Island.
- Long Island beaches, due to the close proximity to heavily populated areas, attract mostly local residents. In fact, about 40 percent of Long Island swimmers reside in Long Island, while 90 percent reside within the New York metropolitan area. Thus, only 10 percent could be classified as tourists residing outside the metropolitan area.

Although the above data refers to nonpool swimming, it is also applicable to Atlantic Beach swimming as the vast majority of nonpool swimming occurs on the ocean rather than on the Long Island Sound side of Long Island.

Attendance trends at major Long Island beaches are shown in Table 22 for the 1974 to July 1976 period. This data is based on traffic count records and relates to the number of persons visiting the beach area daily - only some of whom actually swim in the ocean. During 1974-1975

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[1] Robert Moses Beach is located in close proximity to Jones Beach and is included within Jones Beach attendance estimates.
[2] Forecast of Outdoor Recreation in New York State, 1970-1990.

Table 22

MONTHLY ATTENDANCE PATTERNS AT SELECTED LONG ISLAND BEACHES, 1974-1976

	Estimated Combined Beach Attendance At Jones Beach State Park and Robert Moses Beach State Park			Percentage Change		Estimated Beach Attendance at Smith Point Suffolk County Park			Percentage Change	
	1974	1975	1976	1974-1975	1975-1976	1974	1975	1976	1974-1975	1975-1976
January	498,500	556,000	435,800	11.6	(21.6)	12,600	17,400	10,800	38.1	(37.9)
February	319,500	450,200	582,100	40.9	29.3	7,000	12,800	23,100	82.9	80.5
March	510,200	635,700	675,500	24.6	6.3	14,000	23,400	25,100	67.1	7.3
April	819,300	661,800	969,700	(19.2)	46.5	34,700	28,600	55,800	(24.1)	95.1
May	1,043,900	1,530,800	954,400	46.6	(37.7)	54,800	102,800	60,200	87.5	(41.4)
June	1,888,400	2,263,000	1,640,800	19.8	(27.5)	113,200	174,000	102,100	53.7	(41.3)
July	3,569,800	3,279,500	2,709,400	(8.1)	(17.4)	269,500	317,600	248,000	17.85	(21.9)
August	3,163,500	2,633,800		(16.7)		242,500	254,200		4.8	
September	1,095,800	780,500		(28.8)		60,600	41,700		(31.19)	
October	765,600	700,900		(8.5)		31,800	31,200		(1,89)	
November	616,800	689,500		11.8		22,600	28,100		24.3	
December	472,400	460,900		(2.4)		11,200	11,900		6.25	
Annual Total	14,763,700	14,642,700		(0.82)		874,500	1,043,700		19.35	
Year to Date Totals (Jan- to July)	8,649,600	9,377,100	7,967,700	8.4	(15.0)	505,800	676,600	525,100	33.7	(22.39)

Source: Long Island State Park and Recreation Commission.

over 14.5 million recreationists visited the Jones Beach-Robert Moses Beach area. This total relates to person days and includes many visitors going to the beach area several or more times annually. Smith Point Beach, located some 50 miles further east and more removed from major population centers to the west, totaled about 1.0 million recreationists per year during the 1974 and 1975 period.

The table also provides data on 1976 attendance from January to July. As shown, attendance at both beaches is significantly lower during the first half of 1976 when compared to similar periods in 1974 and 1975. The major reason for this decline is attributed by local and authorities to the marine pollution which affected portions of the Long Island coast during the late May to early July 1976 period. Specifics of this pollution and the resulting impact on recreation use and travel patterns are discussed below.

Impact of Marine Pollution on Long Island Beach Areas: During the June 15 to June 28 1976 period, a substantial amount of floating sewage and debris affected some 70 miles of ocean beaches along the Long Island shore. During these two weeks, a majority of the swimming beaches from Atlantic Beach in southeastern Nassau County to Easthampton Beach in southeastern Suffolk County were closed for two or more days. According to local health department officals, this marine pollution was caused by a combination of factors, including:

- sewage outfalls in New York City and New Jersey;
- sludge processing tank explosions;
- upheavals on the ocean floor in the New York Bight (a sludge disposal area in the waters a few miles south of Rockaway Point on Long Island);
- sewage from pleasure boats and ships.

The impact on beach attendance and spending due to this pollution was significant. According to a survey conducted by Congressman

J. Downey's staff (D. New York), the local economy suffered a loss of $15 to $20 million during the two-week period of beach closings. The total loss to the economy was even greater as attendance at area beaches remained depressed for two to four weeks following these closings, as many persons stayed away.

According to this survey, many local businesses experienced a loss in sales ranging from 25 to 50 percent. As would be expected, the businesses closely related to the ocean, such as sea food restaurants, marinas, tackle and bait shops and fishing boats were affected most severely. In addition, several types of transportation services such as ferry boats, taxis and shuttle buses experienced business losses greater than 50 percent during the pollution period. Predictably, retail establishments which catered to local area residents were only slightly affected, while tourist-related businesses suffered heavy losses.

The impact of pollution on area beaches was compounded by the fact that local health officials overreacted to the situation and closed many beaches unnecessarily. Also, the press carried exaggerated reports of the quantities of sewage affecting area beaches and generally did not specify which beaches were impacted. As a result local area residents concluded that all Long Island and New Jersey beaches were polluted and made little effort to seek out unaffected beaches.

The attendance impact of the marine pollution was measured by ERA for three types of beaches, including the following:

- Jones Beach, Long Island - this beach was severely affected by the marine pollution and as a result was closed to all swimming during the June 15-June 28 period.
- Smith Point Beach, Long Island - this beach was only moderately affected by the pollution and was not closed to swimming.
- Seaside Heights, New Jersey - this beach was not affected by the pollution and as a result was not closed to swimming.

In order to test the pollution impact on each beach, daily attendance data was compiled during three periods of time: the period prior to significant levels of pollution (June 1-June 14), the period of pollution (June 15-June 28), and the recovery period (June 29-July 5). Trends in attendance during these periods for 1974, 1975, and 1976 were analyzed. In addition, weather characteristics for each period were determined so that any possible fluctuations in attendance due to poor weather could be identified. Table 23 presents this weather data for each year during the pollution impact periods. As shown, during the period of pollution and the recovery period, 1975 and 1976 recorded similar weather conditions. By contrast in 1974, a higher percentage of rainy days were recorded during these periods which accounted for considerably less attendance at area beaches, as compared to the 1975 data.

Table 24 illustrates attendance at the three study area beaches during the pollution impact periods. During the period prior to significant levels of pollution, attendance declined only at Jones Beach which was the only beach which experienced traces of pollution. However, following this period, publicity regarding the pollution problems on area beaches increased and numerous beaches were closed. During this period of pollution (June 15 to June 28), attendance declined at all three study area beaches, from 50 to 60 percent - even though only one beach (Jones Beach) was actually experiencing significant levels of pollution and was closed. This seems to indicate that the level of pollution does not directly affect attendance at that beach as attendance declined at a similar rate at the two unaffected beaches. This is the case because adverse publicity regarding pollution at one beach diverted the public from going to alternative clean beaches. In fact, officials at Seaside Heights Beach, which was not at all affected by the pollution, indicated that few persons even bothered to inquire as to whether their beach was polluted or not, but instead stayed away. Likewise, the attendance at Smith Point Beach declined substantially even though the Beach was never closed to swimming.

Table 23

WEATHER CHARACTERISTICS AT LONG ISLAND CASE STUDY AREA BEACHES DURING POLLUTION IMPACT PERIOD

	Weather (Percent of Total Days)			
	Clear	Cloudy	Rain	Total
Period Prior to Significant Levels of Pollution (June 1-June 14)				
1974	50%	36%	14%	100%
1975	29	50	21	100%
1976	36	57	7	100%
Period of Pollution (June 15-June 28)				
1974	13%	50%	37%	100%
1975	37	63	0	100%
1976	31	69	0	100%
Recovery Period (June 29-July5)				
1974	57%	14%	29%	100%
1975	43	57	0	100%
1976	57	43	0	100%

Source: Jones Beach State Park.

Table 24

IMPACT OF MARINE POLLUTION ON LONG ISLAND CASE STUDY AREA BEACHES

	1974	1975	1976	Attendance Change from Base Year 4/	
				Number of Persons	Percent Change
Period Prior to Significant Levels of Pollution (June 1-June 14)					
Polluted and Closed Beach (Jones Beach) 1/	886,008	725,016	903,592	179,100	+16.5%
Polluted and Open Beach (Smith Point) 2/	54,711	39,200	80,973	4,600	+ 6.0%
Nonpolluted and Open Beach (Seaside Heights) 3/	n. a.	34,000	79,000	12,400	+18.6%
Period of Pollution (June 15-June 28)					
Polluted and Closed Beach (Jones Beach) 1/	743,472	1,373,232	655,860	-717,372	-52.2%
Polluted and Open Beach (Smith Point) 2/	39,983	113,126	45,383	- 67,743	-59.9%
Nonpolluted and Open Beach (Seaside Heights) 3/	n. a.	121,400	60,150	- 61,250	-50.5%
Recovery Period (June 29-July 5)					
Polluted and Closed Beach (Jones Beach) 1/	948,436	890,140	593,024	-297,116	-33.4%
Polluted and Open Beach (Smith Point) 2/	79,994	90,285	74,126	- 16,159	-17.9%
Nonpolluted and Open Beach (Seaside Heights) 3/	n. a.	136,000	159,300	+ 23,300	+17.3%

1/ Jones Beach and nearby Robert Moses State Park were closed over the June 15 to July 26 period.
2/ Smith Point Beach was never officially closed, although it was affected by the marine pollution.
3/ Seaside Heights Beach was never closed and was not affected by the marine pollution.
4/ Due to similar weather characteristics, the base attendance for the period of pollution and the recovery period uses 1975 data. The base attendance for the period prior to significant levels of pollution was projected based on 1974 and 1975 data and on weather data for these years compared to 1976.

Source: Long Island Department of Parks and Recreation, Seaside Heights Department of Parks and Economics Research Associates.

Although the degree of pollution seemed to have little impact on attendance during the 14-day pollution period, following this period attendance recovered most rapidly at beaches which were least affected by the pollution. As shown in Table 24, attendance at Seaside Heights Beach, which declined by 50 percent during the period of pollution, increased by 17 percent during the 7 days following the pollution. Likewise, Smith Point Beach, which was not significantly affected by the pollution also demonstrated a considerable recovery in attendance - although attendance was still almost 18 percent less than the previous year. Finally, Jones Beach, which was significantly affected by the pollution and closed for a 12-day period, recorded the slowest rate of recovery with attendance down 33 percent over last year during the 7 days following the pollution.

Summary: Through an analysis of attendance trends at the three study area beaches and through discussions with local officials and review of secondary sources, several conclusions can be drawn from this case study experience.

- If marine pollution affects one beach to the extent of adverse publicity and beach closings, other nearby beaches are also affected even though these beaches experienced little pollution. For instance in the New York case study, pollution on certain Long Island beaches had a similar impact on attendance at New Jersey beaches, almost 100 miles away.
- During the short-term pollution impact period (2 weeks), very little divergence from the polluted beaches to clean beaches was evident. However, since almost 90 percent of Long Island beach users live in the New York metro area, it is likely that most chose another form of recreational activity during the pollution impact period rather than search out clean beaches. Thus, there was only a minimal impact on recreation travel costs as a result of the pollution. However, this situation would very likely have changed if (1) the pollution period had been more long-termed and/or (2) the beaches impacted

were located in a destination resort area where recreationists had traveled a great distance to participate. Under these conditions, a significant divergence to clean beaches would be expected.

- Following a period of beach pollution, beaches not affected regain normal usage quicker, while the recovery period at beaches directly impacted is considerably slower.

- The marine pollution affecting study area beaches began before many beaches were fully open for business. Thus, the recorded impact shown in Table 24 is undoubtedly less than if the pollution had occurred during the July or August months.

- In summary, if the logical observations made in the absence of broader, empirical data hold true, it appears from this case study that the degree of impact and divergence effects of marine pollution is a direct function of the timing and length of the pollution period and of the distance traveled to the beach.

The overall attendance loss resulting from marine pollution has been estimated above for the three study area beaches. Based on these findings, a generalized estimate of the impact of this pollution on each study area can be developed. However, since there was no indication of significant travel divergence within each study area due to the pollution (since attendance was down at all area beaches), no alternative travel costs can be developed for this study area. This is the case for the following reasons:

1. Study area beaches record ~~record~~ high visitation from local residents (90%) who generally are not willing to travel significantly greater distances to seek out clean beaches.

2. The pollution impact period was relatively short in duration and occurred at the beginning of the swimming season.

Had either factor not been present in the case study situation, it is possible that significant travel divergence would have occurred.

Nevertheless, the remainder of this report presents methodologies to estimate both the economic impact of pollution on a particular area (using the case study as a guide) and travel cost impacts of beach pollution and clean-up.

Beach Pollution Economic Impact Assessment Method

Based upon the Long Island case study, a fairly simple methodology has been developed to assist local administrators and planners to assess the economic impact of a beach pollution occurrence. The impact to be measured is that associated with beach visitor expenditures.

Formula for Estimating Impact: A suggested formula for estimating the impact of beach pollution on visitor spending is as follows:

$$I_p = V_1 (t_1 E_1 + t_2 E_2), \text{ where}$$

I_p - Income lost in impact area as a result of beach pollution. (N. B. The Solution Value)

V_1 - Estimated number of visitor days lost as a result of pollution. V_1 is determined by examining historical visitation trends and contrasting the average anticipated visitation during the same period of time with the visitation during the pollution impact period. Following adjustments of the historical visitation data for weather, V_1 is obtained in the following manner:

Let V = estimated average visitation during the time of year when the pollution occurs, based on past experience during times of no pollution.
V_p = estimated visitation during the pollution impact period.
Then, $V_1 = V - V_p$

t_1 - Estimated percentage of visitation (V) that would normally be attributable to local visitors.

t_2 - Estimated percentage of visitation (V) that would normally be attributable to nonlocal visitors.

E_1 - Estimated average daily visitor expenditures - local visitors (based on National Travel Expenditure Survey data).

E_2 - Estimated average daily visitor expenditures - nonlocal visitors (based on National Travel Expenditure Survey data).

To determine expenditure impact for selected categories (i.e., transportation, lodging, food, entertainment, gifts, incidentals), input National Travel Expenditure Survey data for category selected into formula in place of E_1 and E_2.

Determination of Visitors Expenditures: The determination of visitor expenditures (E_1 and E_2) for estimating the economic impact of marine pollution at the three study beaches was obtained as follows:

1. Based upon examination of data regarding the origin of most visitors to the study beaches, ERA employed "round trip distance" figures from Table 25. Furthermore, it was assumed that local visitors would reside within the 0 to 199 mile range of each beach, and that nonlocal visitors would not travel over 1,000 miles to reach each of the study beaches.

2. The total estimated 1976 domestic travel expenditure per person day for local visitors is estimated at \$7.30. Thus, E_1 is obtained from Table 25 by referring to the figures under the heading "Round Trip Distance." Since it has been assumed that local visitors would reside within a maximum round trip distance of 199 miles from each study beach, the total expenditure per person day for transportation, lodging, food, entertainment, gifts and incidentals is estimated to average about \$7.30 per day.

3. In order to derive E_2, ERA has assumed that 25 percent resided within 200-399 miles, 25 percent resided within 400-599 miles, 25 percent resided within 600-799 miles, and the remaining 25 percent resided within 800-1,999 miles of the beaches under study. 1/ Following this assumption, we have taken the average of the four expenditure totals per person day as representative of the typical nonlocal travel expenditure per person day which equals \$21.50 per person per day.

Round Trip Distance (Miles	Total Travel Expenditure Per Person Day (\$)
200-399	\$17.85
400-799	23.03
800-999	23.89
Total	\$85.97

$$\frac{\$85.97}{4} = \$21.49 \text{ or approximately } \$21.50.$$

4. Using these average daily expenditure inputs for local and nonlocal visitors, Table 26 presents estimates of the economic input of marine pollution on case study beaches. As shown, Jones Beach, which

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1/While this place-of-residence breakdown reflects general national averages, precise place of origin data was not available for the surveyed beach sites. This assumption was made for the purpose of demonstrating the methodology proposed.

Table 25

ESTIMATED 1976 DOMESTIC TRAVEL EXPENDITURES PER PERSON DAY

Characteristics of Trip or Traveler	Transportation	Lodging	Food	Entertainment	Gifts	Incidentals	Total
Round Trip Distance							
0 to 199 miles [1/]	$ 2.63	$ -	$2.38	$0.66	$0.07	$1.55	$ 7.29
200 to 399 miles	$ 5.26	3.27	$4.76	$1.31	$0.14	$3.11	$17.85
400 to 599 miles	6.72	3.91	5.53	1.44	0.13	3.47	21.20
600 to 799 miles	8.15	3.99	5.82	1.41	0.12	3.54	23.03
800 to 999 miles	9.55	3.71	5.60	1.41	0.10	3.52	23.89
1,000 to 1,999 miles	11.05	4.15	5.82	1.56	0.09	3.53	26.20
2,000 to 2,999 miles	12.78	5.43	5.91	1.82	0.06	3.52	29.52
3,000 to 4,999 miles	14.57	5.52	5.65	1.49	0.06	3.59	30.88
5,000 miles and over	24.41	6.30	6.76	1.55	0.06	3.68	42.76
Trip Duration							
No nights out-of-town	16.66	0.00	0.00	0.00	0.00	0.00	16.66
1 to 2 nights	10.83	3.24	5.78	1.49	0.21	3.65	25.20
3 to 5 nights	11.70	5.15	6.44	1.55	0.13	3.66	28.63
6 to 9 nights	10.27	4.03	5.78	1.44	0.08	2.68	24.28
10 to 15 nights	8.94	4.22	5.67	1.64	0.06	3.55	24.08
16 to 23 nights	7.62	4.34	5.42	1.60	0.05	3.54	22.57
24 to 60 nights	5.73	4.65	5.09	1.56	0.04	3.39	20.46
61 and over	3.02	7.93	4.84	1.57	0.09	3.30	20.75
Number on Trip							
1 person	17.80	8.20	6.66	1.62		3.59	37.87
2 persons	10.15	5.32	6.03	1.56		3.63	26.69
3 persons	6.54	0.85	4.69	1.39		3.32	16.79
4 persons	5.02	0.84	4.59	1.39		3.22	15.06
5 persons	4.08	1.07	4.53	1.24		3.13	14.05
6 or more	2.52	2.10	4.16	1.21		3.04	13.03
Age of Travel Party Head							
Under 18 years	10.70	3.55	4.63	1.38		3.47	23.73
18 to 24 years	9.30	3.00	4.31	1.41		2.90	20.92
25 to 34 years	4.93	3.18	5.12	1.39		3.17	17.79
35 to 44 years	9.07	3.54	5.69	1.33		3.50	23.13
45 to 54 years	11.40	4.65	6.41	1.56		3.78	27.80
55 to 64 years	10.41	5.95	6.04	1.48		3.69	27.57
65 and over	9.21	5.44	5.03	1.48		3.19	24.65
No answer	11.18	5.33	5.15	1.49		3.30	26.45
Education of Travel Party Head							
Elementary school or less	8.57	3.54	4.37	1.45		3.07	21.00
High school	8.27	3.99	5.23	1.44		3.27	22.20
College	11.45	4.69	6.20	1.52		3.64	27.50
No answer	8.39	2.57	3.75	1.50		3.20	19.41
Area of Permanent Residence							
SMSA - central city	10.97	4.86	5.73	1.42		3.51	26.49
SMSA - out of central city	10.54	4.96	5.88	1.53		3.58	26.49
Not in SMSA	8.19	3.48	4.88	1.42		3.14	21.11
Area of Destination							
In SMSA	14.47	5.00	6.03	1.55		3.52	30.57
Not in SMSA	8.28	3.99	5.38	1.45		3.39	22.49
Travel Region of Origin							
New England	10.00	5.96	5.85	1.53		3.52	26.86
Eastern Gateway	11.44	6.26	6.59	1.53		3.80	29.62
G. Washington Country	9.20	4.50	5.65	1.39		3.51	24.25
South	9.47	3.70	5.04	1.59		3.28	23.08
Great Lakes Country	8.57	4.48	5.38	1.38		3.44	23.25
Mountain West	10.17	2.99	5.16	1.44		3.15	22.91
Frontier West	9.38	3.06	5.01	1.49		3.34	22.28
Far West and Hawaii	12.26	3.87	6.13	1.50		3.42	27.18

[1/] Spending for local trips (0-199 mile radius) is not reported in the National Travel Survey and was estimated by ERA, based on recreation travel studies of a similar nature.

Source: U.S. Department of Commerce; and Economics Research Associates.

Table 25 (Continued)

ESTIMATED 1976 DOMESTIC TRAVEL EXPENDITURES PER PERSON DAY

Characteristics of Trip or Traveler	Transportation	Lodging	Food	Entertainment	Gifts	Incidentals	Total
Total - Trips over 200 miles	$ 9.87	$4.25	$5.54	$1.48	$0.10	$3.43	$24.67
Total - All trips	$ 4.55	$1.50	$3.53	$0.96	$0.08	$2.25	$12.89 1/
Means of Transport							
Auto/truck, no camping equip.	6.61	3.99	5.35	1.41	0.12	3.36	20.84
Auto/truck, camping equip.	5.92	1.62	4.55	1.38	0.04	3.36	16.87
Bus	5.55	3.74	4.87	1.78	0.12	2.97	19.03
Train	9.78	3.73	5.00	1.34	0.12	3.16	23.13
Air	27.16	7.06	7.16	1.79	0.08	3.86	47.11
Boat/ship	12.71	2.31	3.82	1.08	0.04	2.96	22.92
Other	9.10	4.49	5.12	1.46	0.09	3.36	23.62
Family Income							
Under $1,999	8.29	3.06	3.43	1.48	0.16	2.16	18.58
$2,000 to $4,999	8.21	3.16	3.32	1.44	0.14	2.09	18.36
$5,000 to $7,499	8.09	3.56	3.97	1.45	0.14	2.00	19.21
$7,500 to $9,999	7.81	3.04	4.18	1.66	0.10	3.44	20.23
$10,000 to $14,999	9.42	4.45	5,75	1.41	0.09	3.50	24.62
$15,000 to $24,999	12.10	5.09	7.64	1.50	0.09	4.58	31.00
$25,000 and over	16.50	6.65	8.32	1.42	0.07	4.66	37.62
Occupation of Household Head							
Professional, technical, managerial	11.98	4.64	6.48	1.45	0.09	3.82	28.46
Farm-owners, mgrs., laborers	8.35	3.63	5.09	1.34	0.12	2.94	21.47
Clerical, sales	10.97	4.72	5.88	1.37	0.12	3.47	26.53
Craftsmen, operatives, laborers	7.74	3.18	4.91	1.55	0.10	3.22	20.70
Household and service employees	8.72	3.30	5.07	1.53	0.12	3.20	21.94
Retired	7.91	5.87	4.87	1.62	0.09	3.15	23.51
Other	8.38	2.72	3.79	1.38	0.13	2.77	19.17
Size of Household							
1 person	13.27	5.82	4.69	1.49	0.18	2.96	28.41
2 persons	10.85	5.94	5.79	1.56	0.13	3.53	27.80
3 persons	10.55	4.21	5.79	1.53	0.12	3.52	25.72
4 persons	9.77	3.48	5.66	1.41	0.09	3.51	23.92
5 persons	8.87	2.91	5.53	1.53	0.07	3.40	22.31
6 persons and over	7.09	3.27	5.10	1.30	0.07	3.30	20.13
Weekend or Other Trip							
Weekend trip	8.42	2.68	4.91	1.45	0.17	3.43	21.06
Not weekend trip	10.80	5.13	5.95	1.49	0.07	3.43	26.87
No answer	9.20	4.57	5.26	1.44	0.09	3.37	18.67
Vacation or Other Trip							
Vacation trip	8.14	3.39	5.32	1.49	0.08	3.47	21.89
Not vacation trip	12.14	5.33	5.88	1.46	0.13	3.38	28.32
No answer	8.12	4.15	4.66	1.41	0.14	3.30	17.12

1/ Includes ERA estimates for trips less than 200 miles.

Source: U.S. Department of Commerce; and Economics Research Associates.

Table 26

ESTIMATED ECONOMIC IMPACT OF MARINE POLLUTION AT LONG ISLAND CASE STUDY AREA BEACHES, JUNE 15-JULY 5, 1976[1]

	V_1	t_1	t_2	E_1($)	E_2($)	I_p($)
Jones Beach and Robert Moses State Park	1,014,488	0.90	0.10	$7.30	$21.80	$8,876,800
Smith Point, Suffolk County Park	83,902	0.90	0.10	$7.30	$21.80	$ 734,100
Seaside Heights	37,950	0.95	0.05	$7.30	$21.80	$ 332,100

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[1] The Figure I_p overestimates the actual economic impact in the region because many of the local visitors sought other forms of recreation within the region.

Source: Economics Research Associates.

Table 27

SUMMARY OF MARINE POLLUTION IMPACT ON VISITATION AT LONG ISLAND CASE STUDY AREA BEACHES, 1975-1976

	1975-1976 Decline in Beach Visitation (V_1)		
	June 15-June 28	June 29-July 5	Total
Jones Beach State Park and Robert Moses Beach State Park, Long Island, New York 1/	(717,372)	(297,116)	(1,014,488)
Smith Point, Suffolk County Park, Long Island, New York	(67,743)	(16,159)	(83,902)
Seaside Heights, New Jersey	(61,250)	(c23,300)	(37,950)

1/Jones Beach and nearby Robert Moses State Park were actually closed from June 15 to June 26. Both Smith Point and Seaside Heights were never officially closed.

Source: Long Island Department of Parks and Recreation; Seaside Heights Department of Parks; and Economics Research Associates.

lost an estimated one million visitors due to the pollution (as shown in Table 27), was impacted by $8.9 million during the 22-day pollution period. Smith Point and Seaside Heights beaches, which recorded significantly smaller losses in attendance (although the percentage loss impact was similar to Jones Beach), were impacted $730,000 and $330,000, respectively.

Travel Cost Impact of Beach Pollution and Clean-up

A generalized estimate of the impact of water quality on swimming-related travel cost can be made from recently published figures by the U.S. Bureau of Outdoor Recreation and the U.S. National Commission on Water Quality. These estimates are derived through the method illustrated in Tables 28, 29, and 30.

Table 28 presents a methodology for estimating travel costs allocated to other outdoor swimming. As shown, the average per capita expenditures in an average year are estimated at $8.35 per person for persons 12 years of age or older. Of this total, approximately $3.00 is attributable to travel and $2.30 is attributable to food. The $8.35 expenditure is the weighted average of swimming-related trips taken both at home and on vacations. Thus this figure could be applied to a given market area to determine the approximate costs incurred in other outdoor swimming by all area residents. This would provide the base expenditure from which travel divergence estimates could be compared. To estimate the travel cost associated with a particular beach pollution situation, a survey would need to be taken to determine the actual travel divergence or relocation pattern. Travel cost factors could then be applied to the travel divergence data to arrive at costs incurred (or served) by either returning to a clean beach or avoiding a polluted beach.

The data in Table 29 presents incremental costs per mile and can be applied to the profile divergence pattern (as estimated through a survey) of the market area to estimate additional travel costs.

In summary, the following steps would need to be taken in order to estimate the impact of marine pollution on a hypothetical market area of 100,000 persons:

1. Determine average recreation travel cost resulting from other outdoor swimming.

Table 28

METHODOLOGY FOR ESTIMATING THE RECREATION TRAVEL COSTS RESULTING FROM OTHER OUTDOOR SWIMMING

Round Trip Miles	Percent of 1/ Population Participating in Other Outdoor Swimming	Number of 2/ Participant Days per Person in Other Outdoor Swimming	Annual Expenditures per Person Resulting from Other Outdoor Swimming Related Trips 3/						
			Transportation	Lodging	Food	Entertainment	Gifts	Incidentals	Total
0-199	20.40%		$ 1.70	$	$1.53	$0.43	$0.05	$1.00	$ 4.71
200-399	5.71		3.41	2.12	3.08	0.85	0.09	2.02	9.46
400-599	2.76		4.35	2.53	3.58	0.93	0.08	2.25	13.72
600-799	1.37		5.28	2.58	3.77	0.91	0.08	2.29	14.91
800-999	0.77		6.19	2.40	3.64	0.91	0.07	2.27	15.48
1,000-1,999	1.45		7.16	2.69	3.77	1.01	0.06	2.27	16.96
2,000-2,999	.90		8.28	3.52	3.83	1.18	0.04	2.28	19.13
3,000-4,999	.25		9.44	3.58	3.66	0.97	0.04	2.32	20.01
5,000 and over	.07		15.88	4.08	4.38	1.40	0.04	2.38	28.16
Total/Weighted Averages	33.68%	2.99	$ 2.95	$0.97	$2.29	$0.62	$0.06	$1.46	$ 8.35 4/

1/ Round trip miles of other outdoor swimming is shown in Table 2.3 for outings, trips and vacations in the study Outdoor Recreation: A Legacy for America. These percents were distributed by participation rates, as shown in Table 3.3 (page 110) and combined to form a composite participation rate index by round trip miles as shown above. The base participation rate of 33.68 percent is a national rate derived from regional rates shown in Table 2.2.

2/ According to the source referenced above, the average participation in other outdoor swimming participates in this activity 8.87 times. Since 33.68 percent of the population participates, then the total population participates on the average of 2.99 times per year (33.68% x 8.87 times per participant equals 2.99 times per person). This per person rate, then, applies to the total population.

3/ According to the National Travel Expenditure Survey (see ERA Table 25), travel expenditures per person day average $12.89. Since this source lists travel expenditures as a function of distance traveled, then transportation related costs due to other outdoor swimming trips can be estimated. The numbers shown above relate to expenditures per person per year and can be applied to a given market area (population 12 years of age and over) to estimate other outdoor swimming travel costs. These figures have been computed by multiplying average daily travel expenditures as estimated in the National Travel Expenditure Survey (see ERA Table 25) by the annual number of days the average person participates in other outdoor swimming (2.99 as shown in Column 2 above). Since the average participant in other outdoor swimming accounts for only 2.6 hours per day (Table 5.4, page 209) of Outdoor Recreation: A Legacy for America, total daily travel cost overstates costs attributable to swimming. Thus, only 22 percent (2.6 hours ÷ typical 12-hour vacation day) of total daily costs have been allocated to swimming, as shown in the following example (2.99 x $12.89 x 22% - $8.35).

4/ Average travel cost per person per year for other outdoor swimming.

Source: Outdoor Recreation: A Legacy for America, Appendix A. An Economic Analysis by the Bureau of Outdoor Recreation and National Travel Expenditure Survey by the National Data Travel Center. The Bureau of Outdoor Recreation data for swimmers represent figures for adults over 12 years of age and during summer season of June, July, and August.

Table 29

INCREMENTAL TRAVEL COSTS RESULTING FROM BEACH POLLUTION

	Annual Expenditures per Person Resulting from Other Outdoor Swimming Related Trips				
	Per Capita	Incremental Cost		Incremental Cost per Miles	
Round-Trip Miles	Cost	Total	Cumulative	Total	Cumulative
0-199	$ 4.71	$	$	$0.047	$0.047
200-399	9.46	4.75	4.75	0.048	0.095
400-599	13.72	4.26	9.01	0.043	0.138
600-799	14.91	1.19	10.20	0.012	0.150
800-999	15.48	0.57	10.77	0.006	0.156
1,000-1,999	16.96	1.48	12.25	0.001	0.157
2,000-2,999	19.13	2.17	14.42	0.002	0.159
3,000-4,999	20.01	0.88	15.30	0.0004	0.1594
5,000 and over	28.16	8.15	23.45	0.0016	0.161

Source: Economics Research Associates.

Table 30

TOTAL TRAVEL COSTS ALLOCATED TO OTHER OUTDOOR SWIMMING IN THE UNITED STATES

Round Trip Miles	Number 1/ of U.S. Population Participating in Other Outdoor Swimming	Number of 3/ Participant Occasions by U.S. Population in Other Outdoor Swimming	Annual Expenditures by U.S. Population Resulting from Other Outdoor Swimming Trips 4/ (In Millions of Dollars) Transportation	Lodging	Food	Entertainment	Gifts	Incidentals	Total
0-199	33,402,600	296,281,100	$168.8	$ -	$152.8	$ 42.4	$4.5	$ 99.5	$ 468.0
200-399	9,349,400	82,929,200	94.5	58.8	85.5	23.5	2.5	55.9	320.7
400-599	4,519,200	40,085,300	58.4	34.0	48.0	12.5	1.1	30.1	184.1
600-799	2,243,200	19,897,200	35.1	17.2	25.1	6.1	0.5	15.3	99.3
800-999	1,260,800	11,183,300	23.1	9.0	13.6	3.4	0.2	8.5	57.9
1,000-1,999	2,374,200	21,059,200	50.4	18.9	26.6	7.1	0.4	16.1	119.6
2,000-2,999	1,473,600	13,070,800	36.2	15.4	16.7	5.2	0.2	10.0	83.6
3,000-4,999	409,300	3,630,500	11.5	4.3	4.4	1.2	-	2.8	24.3
5,000 and over	114,600	1,016,500	5.4	1.4	1.5	0.3	-	0.8	9.4
Total	55,147,000 2/	489,154,800	$483.4	$159.0	$374.2	$101.7	$9.4	$239.0	$1,366.9

1/ See preceding table for participation rates.

2/ According to the U.S. Statistical Abstract, 163,738,000 persons 12 years and older lived in the United States in 1972. The above number represents the national average participation rate of 33.68%

3/ As presented in the preceding footnote 2, the average participant occasion in other outdoor swimming is 8.87 times.

4/ Annual expenditures per participant occasion are estimated based on data in ERA Table 28 which sources expenditure data compiled by the National Travel Survey. Since the average participant in other outdoor swimming accounts for only 2.6 hours per day (Table 5.4, page 209), total daily travel cost overstates costs attributable only to swimming. Thus, only 22 percent (2.6 hours-typical 12-hour vacation day) of total daily cost have been allocated to swimming.

Source: Outdoor Recreation: A Legacy for America, Appendix A, An Economic Analysis by the Bureau of Outdoor Recreation and National Travel Expenditure Survey by the National Travel Data Center. The Bureau of Outdoor Recreation data for swimmers represent figures for adults over 12 years of age and during summer season of June, July, and August.

    a. Multiply population (100,000) times 80 percent to determine what portion of the population is 12 years of age or older.

    b. Multiply population that is 12 years of age or older (80,000) times average daily expenditure ($8.35 - see Table 28).

    c. Thus, the annual travel cost attributable to other outdoor swimming equals $668,000.

2. Survey market area beaches, both impacted and not impacted by pollution, to estimate extent of travel divergence due to pollution. Survey would determine what percentage of the population was diverted and the average miles traveled to the alternate location. The hypothetical market area result is that 30 percent of the residents (12 years of age and older) diverted to an alternate beach, averaging 250 miles of additional travel. Thus the total market area divergence is:

    a. 80,000 residents times 30 percent of the population who traveled to additional beaches equals 24,000 persons.

    b. Average additional travel cost per person who diverted to a clean beach is determined by multiplying the average number of miles diverted (250) times the incremental travel cost per mile (4.7 cents for the first 200 miles and 4.8 cents for the remaining 50 miles, or a weighted average cost of 4.72 cents per mile as derived from Table 29, Column 4). This equals an additional travel cost of $11.80 per person.

    c. Finally, the average additional travel cost ($11.80) is multiplied by the number of persons who diverted to alternate locations (24,000) to determine the total market area impact of polluted beaches, which equals $283,000 for the case study.

3. Thus, under normal conditions, other outdoor swimming travel related costs equal about $668,000 for the market area. However, due to pollution and the resulting travel divergence, total market area travel costs are estimated at $951,200, or an increase of 42.4 percent.

The data developed in Table 28 can alse be used to estimate the national impact of costs attributable to other outdoor swimming, as shown in Table 30. Based on this data, the overall impact of water pollution clean-up on swimming activity can be summarized as follows:

	No Clean-Up (in millions)	Clean-Up[2] 2.7% Maximum Increase (in millions)
Number of Swimmers	55,147.0[1]	56,636.0
Total Occasions	489,154.8	503,494.0
Estimated Travel Cost[4]	$1,336,900.0	$1,406,970.0

Improving the quality of water to the extent possible, as reported by the U.S. National Commission on Water Quality, would result in a total travel cost associated with seasonal recreational (outdoor) swimming of $1,407.0 million. As indicated earlier, the clean-up of swimming waters would result in a relocation of seasonal recreational swimming from a range of 8 to 28 percent. This would amount to an estimated $112.5 million to $394.0 million in travel costs, respectively, associated with swimming travel relocation. Additionally, referring back to Table 2 and taking the 25 percent proportion of marine recreation shoreline to total U.S. public beach capacity (in miles), it may be further estimated that the swimming relocation travel cost related to marine beaches ranges from $28.1 million to $98.5 million.

1/ U.S. Bureau of Outdoor Recreation; adults over 12 years, summer season (June-August 1972).

2/ See ERA Table 2.

3/ Reflects 8.89 participation rate, U.S. Bureau of Outdoor Recreation.

4/ See Tables 28, 29, and 30. Based upon estimated average travel east for swimmers of $8.35 per day.

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water quality, respondents were willing to pay $20-26 per family per year for improved water quality, indicating that attempts to quantify benefits of improvements on the basis of consumption are misguided, water quality appears to be a highly valued good merit; (4) people are willing to pay more to maintian existing water quality as sites with high water quality than at sites with poorer water quality. Twenty-nine fresh and salt water beaches within 50 miles of Boston were samples for a 13 water quality parameters, and a beach quality catalogue was compiled. Statistical analysis of sampling and questionnaire data included tabulation, factor analysis of water quality parameters to develop water quality indices, correlation analysis between perceived and actual water quality, multiple regression analysis to estimate determinants of willingness to pay and recreation behavior, and specification and estimation of two multi-site models.

Bovet, E. D., Evaluation of Quality Parameters in Water Resource Planning: A State-of-the-Arts Survey of the Economics of Water Quality. Institute for Water Resources, Fort Belvoir, VA. December 1974. 263 pp. To evaluate the economic aspects of water quality, literature was reviewed and results compiled. Chapter 1 contains approaches for analyzing and describing qualitative phenomena, the origins of water contaminants, and categorizes pollutants. Chapter II is devoted to a discussion of classifications and indices of water quality, water uses, effects and damages of water contamination, and water quality requirements and standards for specific uses. Water quality models are discussed in Chapter III. In many cases the purpose of models is to permit planners to determine the probable effectiveness of alternative water quality allocation or enhancement measures. Chapter IV is devoted to the technology and cost of water supply purification while Chapter V is concerned with the technology and cost of waste and receiving-water purification. Chapter VI discusses water quality benefit measurement as based on two major methods: willingness-to-pay and substitution of alternative cost. Chapter VII reviews the economic techniques for optimal water supply purification and allocation and Chapter VIII considers economic techniques for the optimal solution of the pollution problem. Four problems are specifically discussed: waste disposal, effluent charges and control, receiving water quality management, and optimal waste treatment.

Brown, T.L., Reetz, G.R. Swimming Participation and Water Quality in Tompkins County, New York. Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources. Cornell University Water Resources and Marine Sciences Center. 53 pp. Following an intensive literature search, a systematic sample of Tompkins County households were surveyed to determine frequency of swimming participation, the degree to which residents swim in waters not approved for swimming, degree of public understanding and agreement with existing swimming standards, and the degree to which swimming participation is affected by perceptions of water quality. Findings indicated that most of Tompkins County's outdoor swimming occurs in natural area streams that are not regularly monitored by the local health department for water quality. Further, the majority of responding adults could not give an evaluation on the degree of strictness of existing standards for swimming. Attitudes toward water quality appear to have some influence on swimming participation and the choice of a swimming area, but in Tompkins County, other considerations such as convenience were more important.

Bundgaard-Nielsen, M., Himmelblau, D. M. A Note on the Evaluation of Activity Dependent Recreational Damage Cost Functions. University of Texas, Austin. Dept. of Chemical Engineering. Water Resources Bulletin, Vol 10, No 3, pp. 580-585, 1974. Determination of recreation benefits arising from improved water quality is an important aspect of water resources management. To develop the functional relationship three steps must be undertaken: identify the form of the function, estimate the coefficients of the functions through non-linear estimation, and validate the function. Several approaches to developing recreational functions for water quality have been utilized. In the first, using attitude surveys, recreationists' perceptions of water quality are surveyed. Information from such surveys is generally difficult to relate to quantitative water quality factors, although they do isolate quality characteristics important to the public. A second postulates demand over supply functions for water quality, but difficulties in functional form and data generally limit such studies to qualitative interests. A third approach classifies benefits from water quality arising from water based activities requiring certain minimum water quality, but independent otherwise, and water based activities which rise proportionately to imporved quality. Such an approach envisions a family of recreation functions. Estimation of coefficients under this approach can be facilitated through factual information on the physical characteristics of the water system combined with socio-economic investigations and/or subjective assessments of the specific recreation activity's value to yield a quantitative functional form.

Bureau of Outdoor Recreation, Washington, D.C. Recreational Water Resources Problems, April 9, 1975. 4 pp. The recreational use of water resources and the current lack of available information concerning this topic are discussed. Extensive research is recommended in the following areas of recreational water resources: (1) the relationship between the available supply of outdoor recreation areas and the rate of outdoor recreation participation; (2) conflicts between recreational and non-recreational use of water resources; (3) the distinction patterns of recreationists in order to properly assess recreation potentials of a given study area, (4) the legal, institutional and economic restraints that prevent the private sector from further providing recreational opportunities; (5) the optional biological, physical, and sociological capacity of recreation resources; (6) the environmental impacts of recreational use of water resources, and (7) legal and physical problems which prevent access to existing water areas, generally, the availability of outdoor recreations areas, facilities and programs is a significant influence upon the extent of outdoor recreation participation. More adequate knowledge about this relationship would greatly assist in the planning project areas for public use.

Burnham, J.B. A Technique for Environmental Decision Making Using Quantified Social and Aesthetic Values, Battelle-Pacific Northwest Labs., Richland, Wash. Report No. BNWL-1787, February 1974. 244 pp. Correlation and regression analyses were used to combine social values with techno-economic values inherent in site selection based on six hypothetical nuclear power plant designs/site options and a set of rating scales for evaluating the acceptability of eight characteristics of each option in

two different geographical locations. Eight social value criteria, including economics, water quality, air quality, animal/plant life, cultural/recreational, health/ safety, aesthetics and land use, were used as weighting factors. The survey was administered to three Seattle population groups: environmentalists, high school students, and businessmen, and was designed to measure the respondent' direct weighting of the eight criteria by ranking each criteria in order of importance. The relative weights of the criteria were also measured indirectly by rating each (on a scale of one to seven) for each option and also making an overall judgment of the acceptablility of each design option. A method was successfully developed to quantify aesthetics by fundamental equations expressing the relationships between viewscape quality and its basic components, and which is described in detail. The analyses indicated that near-maximum predictability could be achieved using as few as three of the eight impact categories as predictors of overall acceptability of the nuclear power plant.

Capel, R.E., Ross, C.B. Lake Location and Quality as Determinants of Potential Recreation Benefits: A Study of Selected Laked in Manitoba. Manitoba Univ., Winnipeg, Dept. of Agricultural Economics and Farm Management. In: Proceedings Symposium on the Lakes of Western Canada, June 1973, Water Resources Center and the Dept. of Extension, Univ. of Alberta, Edmonton, pp. 114-144. A method is proposed to help lake developers choose the plan which will provide maximum benefits. Recreational demand is considered regionally, rather than individually for each lake development project. A model developed to describe visitation by city residents to recreation areas, considers population, site location and quality, and competition between sites. Visitation patterns of Winnipeg and southwest Manitoba residents were studied. Recreational area quality indices based on presence of beaches, fishing, docks, and ramps were determined for 61 areas with various water resource qualities. The model indicated that number of visitor days spent in a recreation area per year to town residents per capita of that town's population was a function of distance from town to area and of the recreational area quality index. Data was obtained by mail questinnaires and park gate traffic counts. The model can project visitation to actual or hypothetical parks. Using travel cost techniques, demand curves can project benefits for benefit cost analysis of alternative plans. It provides a framework for planning and study of development proposals, and indicates future research needs. Lake quality indices, relationships between adjacent areas, and effects of number of recreational areas on total visitation are variables to be considered.

Ching, C.T. K., Frick, G. E. The Effect of Park Use on Surface Water Quality. New Hampshire Univ., Durham. Water Resources Research Center. In: Growth and Change, A Journal of Regional Development, Vol 5, No. 4, pp. 15-20. October, 1974. Pawtuckaway State Park has been operating since 1966. This large rural park fronts on a portion of Pawtuckaway Lake which is 800 acres in size. Numerous clusters of seasonal houses are adjacent to the shoreline and the park. During the summer of 1971 an intensive study was made of (1) lake water quality as affected by park usage, and (2) the attitudes of private water-oriented landowners toward the park. Both the water quality analysis and the attitudinal survey indicated that the establishment of Pawtuckaway State Park has not had

an adverse effect on the quality of the immediate environment. Coliform bacteria, a water quality indicator, occasionally exceeded the state standard at the beach area. However, neither climate, attendance, weekend use (as high as 8,000 people) nor time were significant determinants of the coliform level. The majority of the 90 landowners interviewed held favorable attitudes toward the park, including an opinion that the park improved their property values.

Coastal Plains Center for Marine Development Services, Wilmington, N.C. Report of the Conference on Marine Resources of the Coastal Plains States, December 5-6, 1974, January 31, 1975. 73 pp. This is a compilation of scientific and technical information submitted by various participants of the conference on marine resources of the coastal plains states. The coastal plains regional commission created the coastal plains marine center which sponsored the conference. The center assists in the development of marine resources in the states of North Carolina, South Carolina and Georgia by functioning as a clearing-house for information on the marine environment of the region. Various articles deal with aspects of sport fishing in the region, including recreational fisheries, marine-based recreation and tourism of the coastal plains states, the seafood market development, and three articles deal with recent developments in coastal zone planning at the state level. The booklet also contains an article by the study director of the Coastal Plains Regional Commission concerning the deepwater terminal study.

Cole, R. A. Environmental Changes in Lake Erie and Their Future Impact on Lake Resources. Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife. 1973. 1106 pp. Human-induced changes in Lake Erie and

how they affect its current and future uses are discussed. Guidelines are suggested for comprehensive, interdisciplinary planning of the Erie Basin based on assessment of the lake's resources and probably future demands. A generalized analysis of social costs and benefits indicates that a total ban on waste effluents into the lake would not be justified until the discharges begin to interfere with the total resource value of the lake. However, a modified form of pollution control would be appropriate even though it would not be compatible with present cost-benefit concepts. Conflicts over commercial and recreational uses, planning strategies, and bureaucratic inadequancies are discussed. Conficts over uses and future demands, particularly as affected by energy shortages, are translated into resource values to point out the need for rigorous resource evaluation before costly management schemes are instituted. Appropriate resource management directions, other than the traditional justifications, are proposed. The impact of eutrophication on domestic water, the effect of phosphorus removal from domestic wastes, the impact of shipping, erosion from agriculture and construction, commercial and sport fishing industries, cooling and industrial water demand, industrial wastes, and the various recreation demands area evaluated in a simple cost-benefit analysis.

Ditton, R. B. Recreational Lakes...What are the Problems. Wisconsin Univ., Green Bay. Recreational Resource Planning. In: Conference on the Management of Recreational Lakes, May 17-18, 1972, Wisconsin University Center, Marinette County, pp. 25-30. Recreation and tourism is the second largest industry in Wisconsin with water as the key element. Socio-economic determinants and extensive water resources in Wisconsin have caused a demand-supply conflict. Two categories of problems have been recongnized: physical lake problems and water surface use problems. Growth of nuisance weeds and organisms due to increased sedimentation and nutrient input threaten aesthetic values, cause health and safety problems, and affect fish populations. Judgement of water quality by the public, biologists, water chemists, or limnologists varies. Water level manipulation and landfills also affect recreational values of lakes. Conflicts in water surface use frequently occur between boat fishing, water skiing, pleasure boating, and swimming between water and shoreland uses. Surveys can help clarify water use problems. Studies of Lake Noquebay, Wisconsin, are discussed, In addition to zoning, the extent of public access is important in resolving water surface conflicts. Resolution of conflicts must be based on an equitable balance betwen the public's right to use water for recreation and the property owner. The public is uncertain as to which agency is responsible for solving these problems. Comprehensive watershed planning can optimize recreational lake values and can prevent many of these problems.

Ditton, R. B., Goodale, T. L. Recreational Uses of Green Bay: Bay/Non-Bay Users Compared. Wisconsin Univ., Green Bay. Leisuire Sciences Collateral. In: Proceedings 15th Conference on Great Lakes Research, April 5-7, 1972, Wisconsin Univ., Madison, International Association Great Lakes Research, pp. 729-736. Managing the Water quality of Green Bay and tributary water requires knowledge of the extent of recreational usage if interaction conflicts between water uses are to be minimized, if not eliminated. Following the development of a reliable interview schedule, a survey of permanent and seasonal resident heads of households was conducted throughout the five-county study area adjacent to the bay, i.e., Brown, Door, Keqaunee, Marinette, and Oconto. The proportion of a representative sample of heads of households in the counties who use Green Bay for recreation are identified. While seven of ten household heads interviewed participated in fishing, boating, or swimming, only three of ten had used Green Bay during the preceding twelve months, indicating that the bay was not a focal point of waterbased recreation among residents of the study area. The data suggest that the use and location of use of Green Bay waters for fishing, boating, and swimming is related to participants' perception of the Bay's water quality and characteristics. Bay users were more troubled by winds, water temperature, and cloudiness, were more deterred from further participation by 'dirty water,' and were inclined to allocate more money for water quality improvement.

Dornbusch, D. M., Falcke, D. O. A Generic Methodology to Forecast Benefits From Urban Water Resource Improvement Projects. Dornbusch (David M.) and Co., Inc., San Francisco, Calif. 1974. 173 pp. Environmental amenities with locational relations to residential property are reflected in the market price for that property. A model expressing the relationship between benefits. Measured by changes in real property values, and water quality improvement, was estimated using econometric techniques and opinion surveys. Results showed that lay people relate water quality in terms of the following categories listed in order of perceived importance: (1) wildlife support capacity, (2) recreation opportunity, and (3) aesthetic comprising industrial wastes, clearness, odor, debris and algae. An index measuring residents' perception of water quality changes was constructed to reflect the relative valuation of each category and the sensitivity of benefit gains to threshold and leveling-off effects. Residents' opinions about water quality changes at a given water body differ sharply and non-systematically from those of water quality experts. The amount of benefits in terms of increased property values derivable from water pollution abatement varies with perceived water quality change, type and size of water body, and, most significantly, extent and character of non-waterfront residents' visual and physical access to the water body. A generic method to assess property value changes in terms of these variables is presented in tabular form. No regional variation in the attainable benefits was detected.

Dudley, R. H., Hekimian, K.K., Mechalas, B. J. Scientific Basis for Determining Recreational Water Quality Criteria. Lockheed Missiles and Space Inc., Sunnyvale, Calif. Journal of the Water Pollution Control Federation, Vol. 48, No. 12, pp. 2761-2777, December 1976. The development and application of a scientific methodology to evaluate risk to water recreationists as a function of each independent environmental factor is described. A mathematical model was developed to assess the risk of ill effect to a recreationist entering or using a body of water having a given hazard distribution. Herein, the incorporation of all relevant published data into the methodology using the factor salmonella as an example is illustrated. That is, the study correlates all known published (1) dose-response data for salmonella, (2) measurements of salmonella in water, and (3) estimates of risk of illness as a function of salmonella in water. The result is a curve of the quantitative risk to the recreationist as a function of the two salmonella subfactor criteria.

Florida State Univ., Tallahassee. Dept. of Economics. Benefits from Water Pollution Abatement, Coastal Waters, (Volumes 1 and 2). National Commission on Water Quality, Washington, D.C. Report NCWQ 75/88, April 1976. 617 pp. Estimates are made of the incremental benefits which will accrue to commercially harvested marine (coastal and ocean) species and related recreational use of marine species with respect to marine harvestibility, biological productivity and opportunities for mariculture, as a result of the requirements of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500). If the law is properly implemented, most shellfish areas will be opened by 1980-1985. While the exact response of changes in marine productivity due to projected water quality improvment is not known, it is estimated that catches would increase at a declining rate. Because these water quality improvements will probably influence both mariculture and wild stock equally, not net or differential benefits accrue to mariculture. It is anticipated that improved water quality will increase recreational days fished. Included are regional price and employment impacts estimated to result from the projected increase in commercial catch and recreational fishing days.

Fuhriman, J. W. An Overview: The Development of Aesthetic Opportunity Criteria as it Relates to the Planning Process; Utah State Univ., Logan. In: Toward a Technique for Quantifying Aesthetic Quality of Water Resources. pp. 22-31, October 1974. Considered is the quantification of aesthetic opportunities as they relate to water resources - the interface between aesthetic opportunity and other relevant planning and design concerns in clarified. Any aesthetic opportinity quantification system should provide a means for evaluating the relationship between

aesthetic opportunity and the inherent quality. Such a system should be developed to yield insight into aesthetic opportunity as it relates to a given broad-scale region and into the aesthetic opportunities that exist in relation to a given function and a specific landscape/waterscape. Moreover, the system should be readily adaptable to any planning methodology. A cursory review is given of some current environmental planning methods and related attitudes/values. Many approaches use a systematic study of natural and cultural resources to determine the inherent qualities of a particular region or site for land use purposes. These resource qualities are interpreted in terms of their capacity to withstand impact and/or their ability to be attractive to a given activity or range of activities. Described is a study for determining the attractiveness of a particular site for a given function of activity. All potential activities were divided into three areas -- recreational, residential, and transportational-- and were grouped according to severity of impact on major site resources. The determination of activities through impact-attractiveness studies provides opportunity for an increase focus regarding observer-use response to the environment.

Gardner, J.S., Frankland, P. Public Evaluation of Water Quality and its Impact on Recreation: A Case From Iowa, Waterloo Univ., (Ontario). Dept. of Geography. Institute of Urban and Regional Research, University of Iowa City. Technical Report No. 38, December 1974. 17 pp. The Iowa River and Coralville Reservoir, a multi-purpose flood control project where recreation has become a major function of the project, were studied to determine the impact of water quality on the degree of participation in and enjoyment of water-based recreation. River valleys providing natural forest cover for wildlife and sites for artificial lakes are the recreational focal points in Iowa. Recent surveys indicate that at least 80% of users of the area do so because of water-based recreational opportunities. Primary purpose of the study was to find how public evaluation of water quality differed from scientific standards of water quality. Scientific standards required accepted levels of pathogenic organisms (expecially fecal coliform), toxic or skin-irritating substances, and objectionable doors or floating material. However, subjective evaluations used as criteria: trash and junk, muddy water, smell, scum, foam, taste, rough fish and dead fish. Subjective evaluations of water quality discouraged participation despite water being declared safe for recreational purposes according to state standards. Fifty-seven percent of the river basin sample refused to let their children swim in river water because of its poor quality. It was found that subjective evaluation of poor water quality did not dampen enjoyment of those who do participate.

Glick, P.M. The Changing Law on Social Values in Water Use. National Water Commission, Arlington, VA. In: National Water Commission: A Review of Some Issues, Proceedings of a Seminar series, P.M. Ashton, Ed., Virginia Water Resources Research Center, Blacksburg, Virginia. Bulletin 75, pp. 76-87, July 1974. Two major problems that American society faces--the need for additional public recreational facilities, ways of getting them, and ways of protecting them and the reduction of losses in life and property due to floods--comprise the 3 topics discusses relating to the wise use of the nation's land and water resources. The first, public rights of access and use of shorelands and beaches for greater recreation, is becoming more important as public demand for recreational facilities is burgeoning due to expanding population, more leisure time, and more money to finance leisure activities. Public agencies can aquire the land by eminent domain, by adverse possession or prescription, by recorded private permission, or by the public trust doctrine whereby shores of any navigable stream are subject to public access and use. Secondly, the need for legal protection of instream water use is discussed. The major valuable instream uses include aesthetic value, recreation, fish and wildlife habitat, and preservation of water quality due to its self-purifying capacity. Existing legal obstacles expecially in the western states to protect instream water uses, particuarly the difficulty in acquiring a water right for low-flow augmentation due to the appropriation doctrine, need to be removed. The third topic covered is the need for floodplain management programs. Including nonstructural measures based on state and local regulation of the use and occupancy of floodways and floodplains to supplement the building of levees, dams, and reservoirs for flood control and flood protection. State and local adoption of enabling acts and local ordinances are encouraged.

Gum, R., Judge, R., Kimball, D., Wilson, W. Quantifying Aesthetic Opportunity. Arizone Univ., Tucson. In: Toward a Technique for quantifying aesthetic quality of water resources. pp. 32-51, October 1974. Developed are measures of aesthetic parameters designed for inclusion in the planning process. In dealing with weighting schemes to link elements within and between 'straw man' sectors, herein the aesthetic opportunity sector is disaggregated and the techniques for making preference evaluations at different points in the framework are outlined. Additionally, the paper described how to mathematically link one level of the goal hierarachy with another level. A modification of the 'straw man,' the operational planning paradigm forming the basis of this research, is described. Four basic assumptions are followed (1) societal goals can exist in a branching, tree-like structure; (2) people react to physical, economic, and social facts through their perceptions of these facts, (3) perceptions or mental indicators (i.e. water odor) are the upper structure of the straw man, and the physical indicators (i.e. BOD) are below; and (4) one can aquire directly from people their preferences and tradeoff between various components of the straw man. The research procedure to redefine the straw man was based on a lexicographic analysis of people's perceptions of the components of aesthetic opportunity in combination with a modified delphi process. Developed were ration scales of people's preference for changes in the components of the aesthetic opportunity straw man. Results of experimental runs are described in a comparison of normalized group weights as generated by each technique for the components of water aesthetics: odor, floaters, and clarity.

Gum, R. L., Martin, W. E. Problems and Solutions in Estimating the Demand for and Value of Rural Outdoor Recreation. Arizone Univ., Tuscon. Dept. of Agricultural Economics. Amiercan Journal of Agricultural Economics, vol. 57, No. 4, pp. 558-566, 1975. Described is a large-scale empirical study of outdoor recreation in Arizona which used the individual observations approach for estimating demand relationships, by including the influence of substitute recreation activities, by allowing for individual tastes and preferences, and by developing resource values based upon estimated individual demand relationships. The methodology is detailed and illustrative and summary results are included. Of special importance is the fact that estimates of resource value are as large as estimates of value obtained by the gross expenditures method. The procedure is an efficient and reasonably accurate method for estimating demand and value and can be easily adapted to other areas. The study used a large number of individual observations (by mail questionnaire) and includes the mileage variable. By focusing on all types of rural recreation activities in all regions of the state, it was possible to include the prices of substitute attractions in the regression equations/and by using the individual observation approach, the problems of multicollinearily between cost variables and the distance variables are avoided. It is suggested that the most fruitful area for additional conceptual analysis is in the interpretation of estimates of value developed for nonpriced goods rather than in additional estimation procedures.

Gum, R.L., Roefs, T. G., Kimball, D.B. Quantifiying Societal Goals: Development of a Weighting Methodology. Arizone Univ., Tuscon. Dept. of Agricultural Economics. Water Resources Research, Vol 12, No. 4, pp. 617-622, August 1976. The basic structure of the techcom planning methodology is reviewed. In the context of this system, a weighting methodology is developed to measure preferences regarding the attainment of postulated societal goals. The selected methodology, the Metfessel General Allocation Test, is applied to the hierarchies of three techcom goals relating to aesthetics, economics, and recreation. The weighting methodology is tested with answers to a mail questionnaire randomly distributed throughout Arizona and New Mexico. Examples of the resulting preference weights are presented, and the use of such measures by decision makers is discussed.

Hampe, G. D., Smith, V. E., Mitchell, J. P. Water-Related Aesthetic Preferences of Wyoming Residents. Wyoming Univ., Laramie. Water Resources Research Inst. 1974. 111 pp. The water-related aesthetic values of 237 individuals are analyzed. This study is one of the first to use color photographs on a general population. Important differences were found by age and educational level. The types of scenes preferred most frequently as first and second for both the best-liked and least-liked groups were type III (moving water) and type IV (mountains and water). The type chosen last in both the best-liked and least-liked groups was type V (water, man-made objects). Individuals who were age 56 and over did not look as disfavorably upon those scenes that showed the same order as the younger age groups did. However, educated groups also did not view these same types (V and VI) as negatively as did those who had completed high school and/or above, i.e., the younger generation. Social factors were found to have a slight, but significant influence upon the individual's choice, i.e., age, educational level, years of residence in Wyoming and section of country where the respondent was raised were found to explain about 10% of the variation in the prediction of each type.

Jaakson, R. Factor Analysis of Shoreline Physiography and Perception of Water Level Drawdown by Reservoir Shoreline Residents. Toronto Univ. (Ontario). Water Resources Research, Vol 9, No 1, pp. 81-92, February 1973. Factor analysis is used to examine the relationship between variations in shoreline physiography and perception of water level fluctuation by reservoir recreation users. Three elements of perception are studies: Frequency of objection to water level fluctuation/ frequency with which users feel that recreation enjoyment is reduced by water level fluctuation, and, as an element that may reflect perception, user days of recreation. A test of the relation between factors and water level fluctuation is made by correlating factor scores with storage capacity on 11 reservoirs and three control lakes. Five factors are identified and evaluated in terms of their significance to recreation. The factor analysis consists of a modified principal component techniques, with orthogonal varimax rotation. From the Ontario Recreation Land Inventory data, five physical shoreline variables have been used: (1) wet beach slope, (2) wet beach material, (3) wet beach cliff height, (4) backshore slope, and (5) backshore material. In considering the above elements of perception, water level fluctuation of existing conditions on lakes, the shoreline physiography dimensions may be used in planning new reservoirs or as a guide for an overview of existing reservoirs.

Kalter, R. J. Recreation Activities in the Nation's Estuarine Zone. Cornell Univ., Ithaca, N.Y. In: Estuarine Pollution Control and Assessment, Proceedings of a conference held at Pensacola, Florida, on February 11-13 1975. Environmental Protection Agency Report No. 400/1-77-007A. March 1977. Vol 1, pp 83-94. Determinants of recreation activity are discussed and justification for the provision of recreation services by the public sector outlined. After reviewing the availability of data and other studies pertaining to recreational use, projections of recreation demand are made for selected activities. Economic models based upon a 1972 Nation Recreation Survey serve as the basis for this effort. The implication of these forecasts for the Nation's Estuarine areas is evaluated and policy recommendations, based on this analysis, are provided.

Klapper, H. Limnological Data and Their use in Practical Water Management, (In German). Institut fuer Wasserwirtschaft, Magdeburg (East Germany) Limnologica 9(3), pp. 427-441, 1975. The mechanism of eutrophication in inland lakes in East Germany is evaluated, and the possibilities of lake protection and technical facilities for lake restoration are pointed out. Outdoor recreation at lakes and their surroundings belongs to the nonproductive sphere of the economic structure and is sometimes neglected. Therefore a new method is proposed to show the economic value of outdoor recreation. Copyright 1976, Biological Abstracts, Inc.

Kimmelman, B., Bildstein, K., Bujak, P., Horton, W., Savina, M. Studies in Environment - Volume V - Outdoor Recreation and the Environment. Homer Hoyt Inst., Washington, D.C. Environmental Protection Agency, Report EPA-600/5-73-012E, February 1974. 91 pp. Increases in the descretionary time (time free from 'earning a living') over the past number of years have dramatically increased the pursuit of leisure activities. Reductions in the length of the work week, increases in paid holidays, longer vacations, and early retirement all foster increases in leisure activities, as do the rise in personal disposable income and higher levels of educational attainment. Add to these factors the increase in mobility, and the resulting boom in recreation is almost obvious. The increasing tendency toward recreational activity has notably placed a heavy demand on existing facilities and has also created a shortage of recreational facilities during peak vacation periods. This potential strain on the ecological carrying capacity of recreational areas is an ever-increasing environmental concern. This study focuses on the problems and potentials between outdoor recreation and the environment. The areas studies include recreation on provate land, along coastal areas, national parks, and urban areas. All of the factors contributing to recreational demand--leisure time, education, disposable income, population growth and mobility--are forecasting to increase and will result in increased participation in recreational activities.

Kremer, Jay G. Odor Control Methods, Experimentation and Application.Los Angeles County Sanitation District, Calif. Report, 1969. 71 pp. Described the field and laboratory investiagations conducted by the county of Los Angeles sanitation districts to develop methods, procedures and equipment for odor control of air flows from wastewater treatment plants. The objectives of the project were to: develop means to quantitatively evaluate odor concentrations, formulate systems for removing odors, evaluate the systems for practicality and effectiveness, and determine costs of odor removal. A literature search revealed scant knowledge of practical methods of odor control. A method patterned after ASTM D1391 was found effective and of sufficient accuracy for making quantitative evaluations of odors. A special odor evaluation room was constructed and equipped for odor evaluations by male and female students from a nearby college. Pilot plants were constructed and tested to evaluate various methods of removing odors from air flows of waste water. These included: a conventional activated sludge scrubber, a packed-tower turbulent contact liquid scrubber using activated sludge and various chemicals, and activated carbon absorbtion. Cost comparisons, advantages, and capacities are described for the above methods and for fume incineration. A successful application of activated carbon for odor removal was made at a waste water pumping station. (Poertner).

Lijesten, D. P., Snir, Y., Rosing, J., Skurski, K. Planning for Coastal Recreation Opportunities near Large Urban Areas: A Study Relating Transportation and Recreation, Intasa, Menlo Park, Calif. July 1975. 110 pp. Recreation Research is traditionally either behavior-oriented or directed towards methodologies for economic benefit evaluation of recreation projects, recreation planning generally produces a document indicating how, when and where recreation opportunities are to be provided. General recreation research and functional planning are seldom mutually influential nor do they provide the basis for informed decision making by the public. The thrust of this research was to identify the type of information that the recreation planner should develop during the planning process in order to formulate plans that include the issues of concern to people who will ultimately accept or reject a plan. A sensitivity approach is proposed to develop information on level and geographic distribution of recreational visitation, a key input towards determining the final implications associated with recreation plans. An approach is presented for modeling the accessibility of recreation resources as a function of demand for activities, supply of opportunities, and the highway network connecting demand centers and supply zones. The specific case of planning for coastal recreation opportunities along the California central coastal zone near the San Francisco-

Oakland-San Jose and Fresno metropolitan areas was used to demonstrate the usefulness of the methodology in functional recreation planning.

Mann (Roy) Associates, Inc., Cambridge, Mass. Aesthetic Resources of the Coastal Zone. Office of Coastal Zone Management, July 1975, 208 pp. The purpose of this handbook is to guide state coastal zone management agencies in the preparation of planning elements for the delineation and management of coastal aesthetic resources. The handbook presents background information, definitions, criteria, procedures for aesthetic resource identification and documentation. Procedures for inventorying and mapping are discussed, as are methods and criteria for defining boundaries of geographic areas of particular aesthetic concern and outstanding aesthetic resource areas. Relative merits of major generic methodologies of coastal landscape assessment are identified. Criteria are developed for determining those aesthetic resources which are sensitive to development, and for identifying features of land and water uses and structures which are typically incompatible with specified aesthetic resources. Finally, means for implementation of state aesthetic resource planning by recommendations are identified, including management tools at state, regional, and local jurisdiction levels, and methods by which the public can participate in the aesthetic resource planning process.

Mann, R. Rivers in the City. Praeger Publishers, New York, New York. 1973. 256 pp. The most intensively used and abused resource on earth--the Urgan River--is surveyed in terms of the crises of mismanaged rivers and wasteland riversides and the important aspects of progress in the conservation of the river landscape. A brief discussion is presented of the historical, economic, sociological, aesthetic and technical aspects of

the problem. How fifteen major urban regions have utilized their river landscapes in the process of urban and regional development is described. The urban regions are: Florence (Arno), Venice (The Canals), Amsterdam (Amstel/The Canals), Paris (Siene), Paris Region (Siene/Dise/Marne), Lyons (Sadne/Rhone), Zurick (Limmat/Sihl), London (Thames), London (Lea), Ruhr Region (Ruhr), Rotterdam (Rhine/Meuse), Tyneside (Syne), Washington, D.C. (Potomac), Boston (Charles), New York (Hudson). Linking the old and new to provide recreational facilities and aesthetic setting by utilizing urban river landscapes (Amsterdam and Paris) is contrasted with situations created by heavy industrialization and growth problems along urban river banks (London and Tyneside). Encroachment of high-rise buildings, expressways, parking lots and ill-designed creation structures threaten riversides of Washington, D.C., Bostin, Paris and Zirkch. Use of knowledge and experinece, sufficient funds, and planning on the broadest scale must be employed to preserve and promote urban riversides of high environmental quality.

McConnell, K. E. Congestion and Willingness to Pay: A Study of Beach Use. Rhode Island Univ., Kingston. Dept. of Resource Economics. Land Economics, Vol 53, No. 2, pp. 185-195, May 1977. A model is developed for estimating demand for congested recreation sites in densely populated areas. The model is used to estimate benefit functions for six Rhode Island beaches. Demonstrating a management strategy for short-run decision making. This is done by comparing optimal beach use implied by benefit function with standards of beach use established by the Bureau of Outdoor Recreation plans for several states. In addition to providing insight into methodology for estimating effect of congestion, the study also suggests a technique which may be used to reexamine standards for beach usage. Reviewed at length is a 1974 survey of the Rhode Island beaches to determine willingness-to-pay. Willingness-to-pay interviews can have important policy implications. By setting different standards at different beaches, planners can increase the social value derived from these resources. And a policy of different standards at different beaches may imply greater available capacity than suggested by a mechanical use of Bureau of Recreation standards.

Nicolson, J.A., Mace, A.C., Jr. Water Quality Perception by Users: Can it Supplement Objective Water Quality Measures. Great Lakes Forestry Research Center, Sault Sainte Marie (Ontairo). Water Resources Bulletin, Vol. 11, No. 6, pp. 1197-1207, December 1975. Personal interviews were conducted with eighty campers in each of three Minnesota State Parks to investigate the water quality perception of the recreationist. Simultaneously, water quality factors were measured or observed as an indication of conditions experienced by the interviewees. Most respondents perceived water pollution strictly on a visual basis, with sewage, public carelessness, industry, and farm fertilizers seen as major causes of water pollution. Seventy percent felt their recreational activities did not contribute to water pollution. Sixty-two percent said their life had not been affected by water pollution, while over two-thirds of the remaining thirty-eight percent listed curtailment of recreation as the primary result. Many mentioned an algal bloom at one park and the strong odor of rotten fish at a second park. It has been concluded that these were the only major problems in the three parks. Some incipient problems, such as nutrient enrichment and the presence of coliform bacteria, were indicated by the measurements. The type and degree of pollution identified by the recreationist could be important through its influence on user evaluations and space preferences. The establishment of relationships between water quality parameters and the perception of the recreationist will provide the manager with a tool to assist in evaluating participation in water-related outdoor recreation in terms of both user satisfaction and water quality.

Parkes, J.G.M. Public Perceptions of Water Quality and Their Effect on Water-Based Recreation, Department of the Environment, Ottawa (Ontario). Water Planning and Management Branch. Social Science Series No. 8, 53 pp., 1973. This study was part of the department of the environment's summer student shoreline survey program. The objectives were to examing the public's perception of water quality, the influence of water quality on water-oriented recreation, and the willingness of the public to pay for improvement. The areas selected for study represent three distinct recreational environments: The maritime coast of Nova Scotia, the eastern township area of Quebec, and the Plains of Saskatchewan. The data gathered concerning recreational use patterns and population characteristics at these sites are intended to be used for future planning.

Polhemus, V.D. Alternative Methods of Evaluating the Economic and Social Aspects of Water Quality. Rutgers - The State Univ., New Brunswick, N.J., Dept. of Economics. M.A. Thesis, January, 1974, 231 pp. Within the decision making process which justifies or rejects programs to restore environmental quality, there is implicit a system of measurement. Described are the problem of deteriorating water quality and the need for a reliable, uniform evaluation system within the existing framework of a free market where personal freedoms are continually being eroded by increasing government activity. Presented are techniques of dollar value, index and group measurement which have been accepted in the past or are currently proposed in the literature. Of all the possible evaluation techniques reviewed, not one was free of criticism/ however, monetary techniques reflecting market values were least objectionable.

Ratliff, M. Public Access to Receding Beaches. Houston Law Review, Vol 13, No. 5, pp. 984-1015, July 1976. The designation of a land mass as a beach does not assure public access to it since areas landward of high tide are subject to private ownership. As ocean waters encroch higher upon the land mass, the public's easement right to the beach are being washed out to sea. Several major legal theories have been adopted to provide for public use and enjoyment of the beach. These theories include the public trust doctrine, prescription, dedication and custom. A serious problem exists, however, in determining exactly where the beach lies. Constant changes in the land-water interface through processes of erosion, subsidence and a rise in sea level create a number of public use--private ownership conflicts. The most feasible method of preserving public beach rights with the least loss to the landowners occurs with the application of a rolling easement. With this concept, the right to the easement moves with the line of vegetation as it recedes in conjunction to the shoreline. Such easements will always allow the beach the mean low tide and the line of vegetation to be reserved for the public regardless of the cause for the recession of the beach.

Sampedro, R. M. Costs and Benefits of the Abatement of Pollution of Biscayne Bay, Miami, Florida. Miami Univ., Coral Gables, Fla. University of Miami Sea Grant Technical Bulletin No. 24, December 1972. 101 pp. The master plan to imporve water quality in Florida's Data County includes closing several small waste water treatment plants presently discharging into inland waterways, suspending septic tank installment permits, and constructing a larger (50 to 80 M. G. D.) plant with high BOD removal efficiencies that will discharge into the Atlantic Ocean and the Gulf stream. Smaller plants will be converted into pumping stations to larger plants, and additional transmission lines and electrical hookups to firms presently discharging into surface water will be added. Estimates, covering initial and ultimate capital and operating costs, indicate totals ranging from $992,605 to $1,038,691 million assuming a six percent discount rate and $668,119 to $706,841 million under a 12 percent rate for the 15 alternative plans evaluated. Total recreational benefits resulting from these proposed plans are also estimated by utilizing the predicted upper limits of the total recreational capacity of the bay. If Dade County recreationalists value a picnic lunch and swim at $4/day and alternative boating activities and $89 to $92/day, benefit will just cover cost utilizing the six percent discount rate. Results of a waste source survey determining the efficiency of 67 plants and of pollution levels at 48 sampling satations within the bay are presented.

Shane, R.M., Day, H. J., Frenkil, S. M., Ho, P.H.P., McMichael, F. C. Riverine Recreational Development-Mathematical Modeling. Carnegie-Mellon Univ., Pittsburgh. Dept. of Civil Engineering. Publication No. R74-6, Oct 1974. 190 pp. Procedures were developed to compare alternative urban riverine recreational sites with regard to potential water quality problems and the level of participation to be expected from various segments of the urban population. The methods developed were applied to the urban portion of the Allegheny River located in Western Pennsylvania. Through the use of basic principles of water chemistry, a pH model was developed in the form of two expressions. The first permits a determination of pH when the concentrations of alkalinity and CO_2--Acidity are known, while the second simulates the change in the hydrogen ion concentration resulting from the gain or loss of carbon dioxide at the air-water interface. Satisfactory results were obtained when sufficient data were available. Digital computer routines were formulated so that numerical procedures necessary for the application of the model can be easily added to existing water quality models. Participation estimation procedures for swimming, boating and fishing were developed using recreational survey data from Pittsburgh, Pa. Socio-economic and demographic variables considered in the analyses included household income, automobile availability, household size, race, age of household head, education level of household head, and accessibility.

Sinden, J.A. A Utility Approach to the Valuation of Recreational and Aesthetic Experiences. University of New England, Armidale (Australia). American Journal of Agricultural Economics. Vol 56, No. 1. pp 61-72, February 1974. A method for valuing extra-market benefits is proposed and tested. The method rests on the empirical derivation of utility functions and indifference maps. Demand schedules were obtained from the indifference maps to provide specific benefit values. The method is compared to the conventional travel-cost method for valuing recreational benefits. It is argued that the utility approach is conceptually superior. Also, the utility data comprise both the benefit values from the indifference maps and direct survey responses as surrogates for utility. These data prove better predictors of consumption than the usual travel-cost variables. The Ramsey model of utility estimation is considered along with its empirical application to determine a single total utility curve for days of recreation at a specific state park in Oregon.

Utah State Univ., Logan. P.J. Brown, Editor. Toward a Technique for Quantifying Aesthetic Quality of Water Resources. October 1974. 91 pp. Presented are the proceedings of a colloquim held in Park City, Utah in October of 1972 to explore various means of incorporating aesthetic considerations into the water resources planning process. The conference brought together a multi-disciplinary group of experts in the field of natural aesthetics in order to design a strategy to examine and develop the aesthetic opportunity sector of the straw man model. the straw man is heavily oriented toward computerized analysis, hence quantifying the aesthetic effects of water resource development alternatives was a primary topic of discussion during the conference. Aesthetic opportunity is one of nine national goals specified by the Office of Water Resources Research in respect to its sponsorship of the development of a new water resources planning system. The function of this report is not to debate the rationality of the aesthetic opportunity goal model, but rather to focus on how one might deal with the quantification of aesthetic quality changes. Organizationally, the report narrows from a general discussion of criteria for evaluation aesthetic quality quantification schemes to specific concern with quantifying landscape aesthetics, and then broadens again to sum up the general topic. One means of measurement is the examination of surveys taken to determine people's preferences for particular elements in the natural environment. Analyzed are those elements constituting the aesthetic nature of experience. Also, aesthetic opportunity is related to the individual's state of physiological security.

Utter, J.G. (W77-02866) A Comparitive Water Quality Analysis of Selected Recreation Lakes and Streams in the White Mountains of Arizona. Arizona Univ., Tucson. School of Renewable Natural Resources. Master of Science Thesis, 1975. 151 pp. This study examines the water quality issue in relation to selected recreation lakes and streams in the White Mountains of Arizona. Four major parameters of water quality were investigated: physical environment factors, chemical nutrient concentrations, fecal bacterial contamination, and visitor use effects. Results indicate intensive recreational use and development may be accompanied by decreased water quality. The research lake exhibiting the most intensive use and development showed significantly greater fecal bacterial contamination in the concentrated use area. Management considerations developed in this report are directed toward assisting recreation land managers in recognizing and preventing present and future water quality problems.

Whipple, W. The Delaware Estuary System, Environmental Impacts and Socioeconomic Effects: Environmental Quality and its Evaluation. Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst. January 1974. 47 pp. The state-of-the-art analysis of the many different approaches to evaluating environmental quality and with particular reference to water-related environments is discussed. A wide spectrum of related methodology and concepts, including biological, anthropological, religious, aesthetic, philosophic and literary writings are

considered in addition to the usual engineering considerations, economic factors and system analysis methodology. Some approaches are shown to be basically inadequate or without logical merit, while the categorization of environmental quality as 'recreation' or 'aesthetic values' is too narrow. The economists' definitions of 'welfare', 'value', and 'utility' theories as related to optimization of environmental quality are reviewed and criticized, with the conclusion that the problem of evaluation is not insuperable. It is possible to describe relevant parameters and to evaluate them in many money terms, and physical standards can be set for achieving social objectives. The basic environmental objective is not a categorical imperative but can have tradeoffs with other social goals, with marginal economic advantages.

Whittemore, R. C., McKeown, J.J. A Study to Define Changes in Pulp Mill Effluent-Contributed Color in Receiving Waters Detected by Human Observers. National Council of the Paper Industry for Air and Stream Improvement, Inc., New York. NCASI Stream Improvement Technical Bulletin, No. 283, 160 pp. December, 1975. The ability of human observers to detect changes in the color of natural waters due to Kraft Mill effluents was studied. Factors affecting the perception of color changes included the baseline color, illumination intensity, the direction of color change, and the sensitivity and color memory of the observer. In general, increases of 20 and 40 color units in the field were perceived by 50 and 90% of the observers, respectively. The ability to detect decreasing changes was somewhat less. Subjects for further research are discussed.

York, D.W., B., Dysart, C., III., I, Gahan, L.W. Multi-Objective Water Resources Planning: Methodology to Achieve Compatibility Between

Environmental Amenities and Economic Development. Clemson Univ., S.C. Dept. of Environmental Systems Engineering. South Carolina Water Resources Research Institute. Clemson, Report No. 55, May 1975. 212 pp. A mathematical model of multiple-use in natural areas was developed. The model represents a unified system for the evaluation of cases where traditional forms of economic development such as industrial manufacturing, surburban residential expansion, or mineral extraction are proposed for relatively natural areas having significant environmental amenity values. The model system is a unique benefit-cost analysis that allows for a rational comparison of the costs and benefits associated with both developmental and environment-related activities. The option values has been incorporated into the analysis, and methods have been devised for the estimation of desirability. Desirability serves as the vehicle for the incorporation of amenity-related values into the analysis. Procedures have also been developed for the estimation of the degree of compatibility to impase constraints on the system limiting the levels of utilization of relatively incompatible activities. An elementary form of the gradient optimization algorithm was included to facilitate the search for the most promising management schemes. The model was applied to a study of multiple-use management of the Great Santee Swamp in South Carolina.